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"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

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A PRELIMINARY SURVEY OF MISSION BAY STATE PARK *

By DONALD H. FRY, JR., and RICHARD S. CROKER

INTRODUCTION

After Mission Bay was declared a State park and a wild life sanctuary, it was desired to learn how the wild life of the bay could be maintained and how sport fishing could be improved. At the request of Assemblyman George B. Bowers of San Diego, two members of the Staff of the California State Fisheries Laboratory (Division of Fish and Game) were sent to the area to make a survey, to report upon the existing conditions, and to suggest methods by which those in charge could improve them. Conditions proved to be far better than might have been expected in an area so close to a city the size of San Diego.

* Contribution No. 134 from the California State Fisheries Laboratory. November 28, 1933.

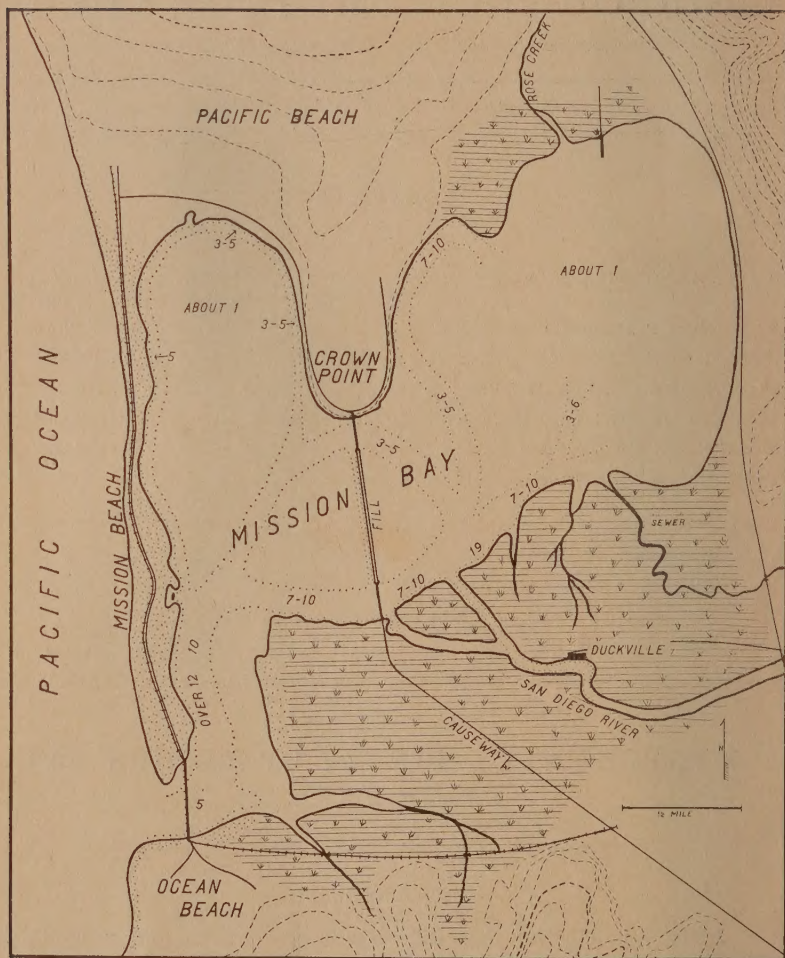


Fig. 1. Map of Mission Bay, San Diego County, California. November, 1933. Contour lines are dashed; contour interval 25 feet; dotted lines mark channels; depths in feet at mean lower low water. Only the roads nearest the bay are shown. There are many marshy islands in the western part of the bay but very few in the eastern section. There may be channels which are not shown, and undoubtedly there are many deep holes. Many small sloughs are not shown on the map.

DESCRIPTION OF MISSION BAY

Mission Bay (False Bay) is an enclosed body of water immediately north of San Diego Bay, California. A square, $2\frac{3}{4}$ miles on an edge, would include all of Mission Bay, nearly all of the marshes which border it on the south, Crown Point which projects into it from the north, and very little else.

Country Surrounding the Bay

Little of the country surrounding the bay is under cultivation. Wherever there are no habitations, gardens or marshes, the land is dry and barren and supports very little vegetation. The various sections are discussed separately below:

The southern marsh is about two miles long and in most places is from half a mile to a mile wide. It is hard to limit it definitely because there is a gradual change from a typical salt marsh to a dry sandy wasteland; many sloughs and strips of marsh extend into this waste. The moist area is a paradise for shore and marsh birds. There are numerous small sloughs in the marsh which are not shown on the accompanying map.

The eastern shore is bordered by a new highway which will soon be part of the main route from Los Angeles to San Diego. Low barren hills rise back of the highway.

The northern marsh is much smaller than the southern one and although important it is far inferior to it as a retreat for birds.

Crown Point is a mesa which projects about three-quarters of a mile from the northern shore. There is a sandy beach at its base. Connecting Crown Point with the southern marsh is a mile of highway which passes over a bridge, a fill, and then a second bridge. This highway crosses the marsh on a causeway and joins the Ocean Beach-San Diego road. The north shore west of Crown Point is of sandy clay, low and barren.

The sand spit (Mission Beach) which separates the bay from the ocean, is $2\frac{1}{4}$ miles long and at no point much over one-quarter mile wide. A combination highway and street car bridge connects the southern end of the spit with Ocean Beach.

Houses and Other Buildings

Ocean Beach, south of the western part of Mission Bay, is a residential district. The sand spit (Mission Beach) is built up fairly solidly with resort type houses. Crown Point is a real estate subdivision. To the east of Crown Point and along the eastern shore of the bay are a few scattered houses. On the southern marsh is a group of a half dozen houses known as Duckville. This spot can be reached by water or by a dirt road from Old Town.

Streams Entering Mission Bay

The San Diego River flows through the southern marsh and enters the bay at about the middle of the southern shore. The stream is dry all summer but is a serious flood menace in the winter. There are a few fresh-water potholes near the point where this stream enters the marsh.

Rose Creek enters the bay through the northern marsh. This stream carries water only during the wet season.

Tecolote Valley drains some water into the bay during rainstorms.

Pollution

There is very little possibility of any pollution which would hurt fishing in Mission Bay. The sewage from the dwellings along the bay shore could have no effect on a body of water of this size. The only industrial plant that could possibly contaminate the bay is the Cudahy Packing Company, a slaughterhouse near the marsh at the southeast corner of the bay. Maximum contamination from this plant would be unimportant. In this area a rather odorous sewer empties into Hardy's Slough. (See map.) It will not bother fishing in the least and is three-quarters of a mile from any place that is ever likely to be used for swimming or picnicking.

Waters of Mission Bay

Crown Point and the highway south of it divide Mission Bay into two distinct sections. The western one is more built up, has many small wharves projecting into it, and has had a good deal of dredging done in places. The inner or eastern section is larger and is much more nearly in the wild state. It is infinitely more interesting from a naturalist's point of view.

The entire bay is very shallow and most of the bottom is of sandy mud. There are many large areas of eel grass. In the parts of the bay farthest from the entrance there are level mud flats; a little nearer the mouth the tide is stronger and has cut shallow channels and filled in shoals. These channels join, become deeper and more sharply separated from the flats. The current in the larger channels is strong but flows smoothly until within about half a mile of the ocean. In this last stretch there is a violent boiling and swirling which keeps the water full of sand and makes steering a boat difficult.

The entrance is about 250 yards wide. The main channel, from the entrance to a half mile east of the San Diego River mouth, is from 7 to 10 feet deep, not considering occasional deep holes. One such hole just east of the river mouth is 19 feet deep in places, and there may be others which are even deeper. Most of the larger branch channels are from 3 to 6 feet deep with occasional holes up to 10 feet or more. All these depths are at mean lower low water, i.e., zero tide. There is plenty of water in the channels to float a skiff at any stage of the tide. On a fairly calm winter afternoon when there is a minus tide, the channels of the eastern bay are as interesting a spot as any nature lover can imagine. Most of the sea life is uncovered; a great deal of the part that is not, can be seen on the bottom. Sharks, skates, rays and true fishes dash hurriedly out of the way and on all sides there are thousands of shore birds feeding and calling noisily. Gulls, pelicans and ducks also abound. The ducks are still wary and hard to approach—the area has not been closed to hunting long enough for them to learn the refuge it provides.

In addition to the natural channels there is a narrow dredged stretch which follows the shore of the western section of the bay. At present this channel is about 5 feet deep. When the dredging was

done, the waste material was allowed to form a low dike between the channel and the mud flats. Boats can cross this dike at high, but not at low tide. A fisherman on the wrong side of the dike may easily be caught by an outgoing tide even though there is plenty of water over the flats.

Another dredged channel parallels the fill which crosses the flats south of Crown Point. The dredging was done to get material for the fill.

Grassy islands occupy a considerable part of the western section of the bay. Most of these are awash at extreme high tides but some are not. Since there was not enough time to chart them properly, most of these islands have been left off the map accompanying this report. The eastern section of the bay contains a very few small grassy islands.

SPECIES OF FISH NOW PRESENT IN MISSION BAY

Fishes Taken by Anglers

A number of species of fishes are regularly sought for and often caught by anglers. The most important of these are listed below. Other species than those mentioned occur in the bay but in small numbers.

1. Rock bass (*Paralabrax nebulifer*). This fish is very common everywhere at all seasons and is taken by anglers in the channels of all parts of the bay. Specimens up to five pounds are to be caught. A desirable species.

2. Spotted rock bass (*Paralabrax maculatofasciatus*). Less common than the ordinary rock bass. A desirable species.

3. Spotfin croaker (*Roncador stearnsi*). Runs of this species occur throughout the year. Taken in the deep channels and holes in all parts of the bay. Five-pound individuals are not uncommon in the bay. A favorite fish with anglers.

4. Yellowfin croaker (*Umbrina roncadore*). Occurs with the spotfin. Equally esteemed by anglers although it seldom exceeds three pounds in weight.

5. California corbina (*Menticirrhus undulatus*). Said to enter the bay in occasional runs. Attains a weight of over five pounds. A desirable species.

6. Diamond turbot (*Hypsopsetta guttulata*). Commonly called "flounder" by local fishermen. Very numerous in all parts of the bay, and taken by anglers at all seasons. The usual length is 6 to 10 inches.

7. California halibut (*Paralichthys californicus*). Occasionally taken near the entrance and in the deep channels. The usual weight in Mission Bay is about four pounds. A desirable species.

8. Smelt (species of family Atherinidae). Caught in various parts of the bay, sometimes in large numbers.

9. Salt-water perch (species of family Embiotocidae). Taken near the entrance, especially around pilings.

10. White sea-bass (*Cynoscion nobilis*) are reported to enter the bay at times. A desirable species.

11. Round sting ray (*Urolophus halleri*). Exceedingly abundant, especially on the mud flats. Seldom exceeds 20 inches in total length. Not sought for but often taken, much to the annoyance of anglers.

Dangerous to bathers by reason of its sting and its habit of lying partly buried on the bottom. By far the worst pest in the bay. Has no game qualities whatever.

12. Bat sting ray (*Aetobatus californicus*). Found in abundance on the mud flats and in the channels. Exceeds 50 pounds in weight and is a hard fighter when hooked. Known to destroy clams. Carries a dangerous sting. Furnishes excellent sport if the fisherman has enough line to stop the first rush.

13. Skates. Several species of skates inhabit the bay. Some attain a weight of 50 pounds. Said to destroy clams. Negligible game qualities.

14. Sharks. Several species of sharks inhabit the bay. Some of these furnish anglers with excellent sport. Individuals of four and five feet in length are common.

Bait Fishes

Large numbers of several kinds of small fishes inhabit Mission Bay. These are used as food by the larger fishes and are employed to some extent as bait by fishermen. The ones that are probably most common are listed below.

1. Top minnow (*Fundulus parvipinnis*). Exceedingly common. Excellent live bait.

2. Long-jaw goby (*Gillichthys mirabilis*). Locally called mud sucker. Good as live bait.

3. Smelt (species of family Atherinidae). Good as live bait.

4. Anchovies (species of family Engraulidae). Not seen by us, but said to be common. Excellent bait, alive or dead.

5. Amphioxus or lancelet. Too small for use as bait but is preyed upon by many species of fish.

Other Species

1. Mullet (*Mugil cephalus*). Very common. Attains a length of two feet. Feeds on vegetable matter and is consequently not taken by anglers.

2. Needlefish (*Strongylura exilis*). Called gar by local fishermen. Very common. Attains a length of three feet. The target of spear wielders on the Mission Beach bridge. Seldom takes the hook.

SPECIES OF SHELLFISH NOW PRESENT IN MISSION BAY

Clams

The mud flats of Mission Bay support a large population of several kinds of clams. The clams are used by man principally as bait and to a small extent as food. The following list of the commoner species has been compiled from Weymouth* and from the observations of the authors of this report.

1. Jack-knife clam (*Tagelus californianus*). Locally called razor clam. By far the most numerous clam in the bay. Most extensively

* Weymouth, Frank W. The edible clams, mussels and scallops of California. Calif. Fish & Game Commission, Fish Bull. No. 4, 1921.

used for bait. Several diggers supply the bait stands with thousands of jack-knife clams daily during the summer.

2. Hard-shell cockles (species of *Chione*).
3. Rock cockle (*Paphia staminea*).
4. Scallop (*Pecten circularis*).
5. Gaper (*Schizothaerus nuttalli*).
6. Washington clam (*Saxidomus nuttalli*).
7. Purple clam (*Sanguinolaria nuttalli*).
8. Wedge shell (*Donax californica*).

Other species probably occur in the bay. The cockles are used to some extent as food and bait. All others, with the exception of the jack-knife clam, appear to be too scarce to be of any importance.



Fig. 2. A view of part of Mission Bay, showing the mouth of one of the larger sloughs; Old Town in the background. Photo by authors, November, 1933.

Crabs

Several species of crabs occur in Mission Bay. Probably none of them reaches a size large enough for human consumption. The crabs are important, however, as a source of food for game fishes. They are noted as bait stealers and as such are a nuisance to anglers.

Other Shellfish

The burrowing shrimp (species of *Callinassa*) is very common in Mission Bay. It is extensively used as bait. Locally called "crawfish." Gathered in large numbers for sale by bait stands.

Mussels (species of *Mytilus*) occur on the pilings of Mission Beach bridge and probably on wharves. Used as bait.

Barnacles occur on pilings of barges and wharves.

FACILITIES FOR FISHING

Bait and Tackle Stands

There are three stands at the south end of the bridge across the bay entrance at which bait and fishing tackle can be purchased. Another bait and tackle stand is located on the causeway at the south end of the southernmost Crown Point bridge. Boats can be rented at these points and at several places along the shore at Mission Beach.

Pier Fishing

The bridge across the entrance is a favorite place for anglers, although the fishing is usually poor. All species listed above are taken occasionally, but the diamond turbot (flounder) is the fish most often caught. The tidal current is very swift—perhaps too fast for good fishing. Spearing is a common practice at this bridge. Needlefish are the usual targets, but owing to their agility and slender shape, are seldom hit. Occasional runs of large sharks cause great excitement and result in broken spears. Large pieces of kelp, carried by the swift current, are an annoyance to the anglers whose lines they foul.

The bridges south of Crown Point are available to anglers. Fishing for flounders, rock bass, croakers and sharks is very good at times.

There are some twenty-three small wharves along the shore at Mission Beach. Most of these are private. Fishing for rock bass and croakers is said to be good at times.

A wharf on the mud flats near the mouth of Rose Creek is in the midst of the best sting ray and skate grounds. It may be possible to catch other species here.

Beach and Shore Fishing

There are beaches at the entrance to the bay on both sides of the ends of the bridge. The beach on the north side extends along the shore of the peninsula. There is a board walk along the most northern part of this beach. Fishing is said to be good sometimes at certain places along the beaches. Rock bass, croakers, flounders and perch can be caught here.

The beaches around Crown Point are favorite fishing spots. Good croaker and rock bass fishing can be had here at times.

There is fishing from the shore at several other places, notably along the causeway rock fill and at the ends of the Crown Point bridges.

Boat Fishing

There are many good fishing grounds—channels and holes—that are accessible only by boat. Croaker fishing is often good in the holes or deep spots.

Some of the channels along the marsh and around the islands are accessible at present only by boat.

The current under the Mission Beach bridge is so swift and tricky as to be dangerous for row boats that venture near the breakers when the tide is ebbing.

CONSERVATION OF WILD LIFE

The most important item in the protection of all forms of wild life in this region is to leave the marshes and mud flats in their present natural state.

Game Fish

The species of game fish which are at present in the bay will probably need no additional protection for many years, *provided* there is no reduction in their food supply.

Bait Animals

By far the largest part of the bait animals taken from the bay are: jack-knife clams, burrowing shrimps (known locally as crawfish), top minnows, and gobies (small fish known as mud suckers). These animals form a very valuable food supply of the birds and game fishes. Since there are noticeable signs of depletion, these forms should be given added protection. Commercial bait men could obtain their stock from San Diego Bay, which is close by and is reputed to have more than ample supplies of bait.

Birds

Mission Bay is closed to hunting—as it should be. At present, there seems to be no need for any sort of predator control, though the problem may arise in the future.

Seals

There is said to be a small herd of seals resident in Mission Bay. These are probably harbor seals (*Phoca vitulina*). They were not seen by us. Fishermen complain that the seals not only destroy game fish but also drive them out of the bay. We are not prepared to say to what extent this is true. However, the seals are an attraction of the park. Many people who do not care to fish do enjoy watching the antics of a herd of seals. Therefore, the seals of Mission Bay should not be destroyed. If their numbers become too large, in the judgment of the California Division of Fish and Game, that body can be empowered to kill a few males. This can be done without in any way endangering the existence of the herd.

Control of Sting Rays

A reduction in the number of sting rays in Mission Bay would be highly desirable. These species form serious competition for game fishes, and the round sting ray is a great menace to bathers. There is no way to eliminate sting rays entirely, but their numbers can be reduced by interesting anglers in taking them. Sportsmen's clubs in the San Francisco Bay region do this by having contests and awarding prizes for the largest rays caught. Once or twice a year great numbers

are taken by the club members, but no consistent effort is made to catch them throughout the year. Contests should be held on Mission Bay, not once a year but continually. The park board or possibly some sportsmen's organization could publicize the contests and award prizes for the largest bat ray and the largest round ray taken each month. While trying to catch large ones, the anglers would destroy hundreds of others and would learn what sport the bat ray affords when taken on rod and reel.

Introduction of New Species

Any native species of plant or animal that could thrive in the bay under present conditions would already be there in numbers. Non-native species form an entirely different problem. An introduced species may seem highly desirable in itself and yet crowd out or devour many valuable native species and become a serious pest. For this reason, new species should never be introduced until a thorough investigation has been made to determine what harm they may do.

Striped bass have been introduced into Mission Bay. These fish may perish, they may migrate out of the bay, or they may grow up and stay in the bay. They will not reproduce and any striped bass fishing will have to be kept up by continued planting. Striped bass require fresh water for spawning and there is no suitable stream entering the bay. It is to be hoped that these fish will not markedly interfere with native game fishes.

The soft-shell clam (*Mya arenaria*) is an introduced species which thrives in San Francisco and Tomales bays. It might do well in Mission Bay if introduced there. It is equal to the native jack-knife clam as bait and is superior as food. However, it might prove more attractive to sting rays (which feed upon and destroy great quantities of soft-shells in northern California bays) and less attractive to game fishes. It might supplant the now abundant jack-knife clam almost entirely and then prove to be useless to local game fishes. (It has supplanted other species in San Francisco Bay.) We do not recommend introducing this or any other species of shellfish into Mission Bay without a fairly extensive investigation, and certainly not without consulting F. W. Weymouth, Paul Bonnot, or H. C. McMillin, authorities on shellfish.

PHYSICAL IMPROVEMENTS IN MISSION BAY

Flood Control Channel

The largest proposed change of which we have heard is to make a wide flood control channel to lead the San Diego River straight out to the mouth of the bay. Several years ago the river was diverted from the same route and forced to enter the bay east of Crown Point. Since then, it has been showing tendencies to silt up the marshes and fill in the bay. The new channel should be a great improvement.

Breakwaters

In connection with the flood control channel, it is proposed to run one or two jetties into the ocean at the entrance of the bay. If this is done, we recommend that fishing be permitted from the jetties, and

if they are of the usual broken granite construction that board walks be placed along them. These would probably be washed away periodically but could be replaced. They would not need to be elaborate, anything is far better than climbing over broken granite.

Bulkheads

We have heard proposals to bulkhead the bay shore in various places. In any wild life preserve, bulkheading should be used as sparingly as possible, and above all things the edges of the marshes should not be bulkheaded.



Fig. 3. Part of the eastern half of Mission Bay. One of the causeway bridges is at the left; Pacific Beach in the background. Photo by authors, November, 1933.

The main channel hugs the western shore for a half mile or so and is said to be cutting the sand away. Bulkheads may be necessary here and would not be particularly objectionable, but we recommend that groins be seriously considered before any construction is started.

Roads

A highway could be built to advantage along the edge of the proposed San Diego River flood control project. Because of the effect on the wild life of the marsh, we recommend that no other roads be built between the flood control channel and the bay. If any are built, all but the very smallest sloughs should be bridged and these should be provided with large culverts. Under no circumstances should any sloughs be blocked.

Dredging

Only a small amount of dredging could be done to advantage in Mission Bay. There should be no attempt to dredge any extensive areas of mud flats. No dredged material should be deposited on the marshes and as little as possible on mud flats. A channel along the eastern shore would attract channel-loving fish to the edge of the new highway. The construction of such a channel would fit in very well with existing plans. It is proposed to fill in some ground between the highway and the water to protect the road from wave action. The material for this fill could most easily be gotten by dredging. Any such channel should be connected with one of the larger natural channels.

As previously mentioned, the dredged channel which skirts the western half of the bay has a low dike between it and the mud flats. A few small cuts could be made through the dike to enable fishermen to get their boats off the mud flats and into the channel when the tide is low.

Construction of New Wharves

The construction of several wharves would have the twofold result of providing additional places to fish and of attracting more fish to enter the bay.

Fishermen would naturally be glad to have more places to fish. Present wharves and bridges were not built primarily for fishing and their location could be better from the anglers' point of view.

Pier-loving fish are not numerous in Mission Bay. If a few good wharves were built, we believe that salt-water perch, kingfish, queenfish, and other species would be attracted to enter the western part of the bay. The wharves should be built with many piles—either concrete or untreated redwood—so that marine growths such as mussels and barnacles would grow in profusion. These animals harbor other creatures, principally worms, upon which fish feed. The inducement for "pile-feeding" fish to enter the bay would improve fishing markedly.

One or two piers could be built not far within the entrance of the bay on the west shore. These wharves should project into the deep channel but should be so located as to be out of the full force of the swiftest current. Currents and depths must be studied carefully before these piers are built.

A wharf could be built from the eastern shore crossing the proposed channel and extending perhaps a hundred yards across the mud flats. It should cross the channel at some place where there is enough current to promote the growth of eel grass. (There are more fish in such places.) This would probably be near the edge of the southern marsh, and there is no reason why the wharf should not cross the tongue of marsh which projects northward along the edge of the highway. Such a wharf would be of interest not only to fishermen but to nature lovers who like to watch the life among the eel grass and on the mud flats, and could be used by nature study classes. It should not be more than two or three feet above high tide line, except where it crosses the channel where it could be somewhat higher to enable boats to pass under it.

The wharf near Rose Creek on the north shore needs repairing. It is in a neglected condition but could be improved by the expenditure of very little money.

We understand that the bridge across the entrance has been condemned and will be replaced by a new one a short distance inside of it. We recommend that the old bridge be left standing as a place to fish. It is probably strong enough to support a few fishermen even if it is unsafe for vehicular traffic.

Bridges and Board Walks

A number of good fishing spots are inaccessible now except by boat. These holes and channels lie along the banks of the marsh and marshy islands. The marsh is under water at extreme high tide, is cut by many sloughs, and at best is an uncomfortable place to fish.

The construction of a few hundred yards of slightly elevated board walks along the edges of the marsh near the south end of the causeway bridges would enable anglers to fish in spots rarely touched before. Foot bridges could be built across sloughs.

TAGGING OF STRIPED BASS *

By G. H. CLARK

A little over a year ago, on September 20, 1932, the first striped bass (*Roccus lineatus*) was tagged under an investigation which had been instigated by the California Division of Fish and Game and strongly urged and sponsored by the sportsmen of California, to determine the movement of the stripers. An agreement had been arranged between the Division and the sportsmen, which provided that the Division furnish the tags and other equipment and keep records of the tagging and of the tags recovered, and that the sportsmen cooperate by assisting in the actual tagging.

On September 20 and 21, 1932, the Division commenced the work by tagging 50 striped bass, after which instructions on tagging procedure were issued and given to the sportsmen's organizations and tagging equipment was also supplied for distribution by these organizations to responsible striped bass anglers, so that these men could tag bass while on their fishing trips. By the end of the first year, September, 1933, 294 fish had been tagged: 158 by the Division and 136 by the sportsmen. During this period of a year, 35 tagged fish had been caught or 11.9 per cent had been recovered one year or less after being tagged and liberated.

It is, of course, realized that no very definite results from tagging can be gained until large numbers of fish have been tagged. Consequently, in order to expedite the work, the Division tagged 179 bass on October 17, 18 and 19, 1933, and 206 on November 7, 8 and 9, 1933. The sportsmen tagged 11 after September 1, 1933, which made the total number of fish tagged 689. Since September, 1933, there were 7 recoveries, bringing the number of recovered tags to 42, or a 6 per cent return of all fish tagged.

The striped bass tags consist of two celluloid discs, one red and one white, one-quarter inch in diameter, and a nickel pin $1\frac{5}{8}$ inches long. The white disc contains a number and the inscription, "California Division of Fish and Game," and the red disc contains the inscription, "Return to Division of Fish and Game, San Francisco, Calif." The tag is put on between the two back (dorsal) fins one-quarter of an inch below the ridge of the back.

Procedure for tagging is as follows: When a bass is caught on the line, it is brought aboard the boat or on shore. The back of the fish is grasped with the left hand, using a wet gunny sack to protect the hand from spines and to prevent rubbing off of more slime than necessary. Next, the hook is removed as carefully as possible, the gunny

* Contribution No. 136 from the California State Fisheries Laboratory, November 14, 1933.

This work was taken over by the writer after E. C. Scofield resigned from the Division of Fish and Game. Scofield had started the work and determined and ordered the type of tag suitable for tagging striped bass. S. H. Dado of the Division made the awls for tagging, has helped with the tagging done by the Division and has kept a duplicate record of tags. I am indebted to the Bureau of Patrol for use of the launch *Quinnat*, in tagging and to the members of its crew for their assistance.

sack thrown over the snout of the fish, and the fish placed on its belly on a flat surface. Then with a small awl (1/16 inch in diameter), a hole is punched through the back of the fish at right angles to the length of the fish one-quarter inch below the ridge of the back. The pin, with the white disc against its head, lettering exposed, is put through the awl hole; the red disc is put on the pin; and the pin is then curled over with a small pair of pointed-nosed pliers. The length of the fish from snout to end of tail is measured and recorded, and the fish is returned alive to the water. The whole operation of tagging takes about one minute and in no case has it seemed to weaken the fish to any extent.

The following Table I is a record of the fish tagged, numbers of tags, date and locality of tagging.

TABLE I

Number of bass tagged	Tag numbers	Date	Locality	Tagged by
5	1- 5	Sept. 20, 1932	Southampton Bay, Carquinez Strait	Division
9	6- 14	Sept. 20, 1932	Middle Ground, Suisun Bay	Division
36	15- 50	Sept. 21, 1932	Middle Ground, Suisun Bay	Division
5	51- 55	Oct. 27, 1932	Mile above R. R. Bridge, Suisun Bay	Division
44	*56-100	Oct. 27, 1932	Middle Ground, Suisun Bay	Division
8	101-108	Oct. 28, 1932	Off Snag Island, Middle Ground	Division
8	109-116	Oct. 28, 1932	Middle Ground, Suisun Bay	Division
34	117-150	Oct. 28, 1932	Mile above R. R. Bridge off Avon Wharf, Suisun Bay	Division
10	151-160	Nov. 11, 1932	Mouth, Andy Mason Slough, Suisun Bay	Sportsmen
3	161-163	Nov. 12, 1932	West of Wheeler Island and east of Noyce Slough, Suisun Bay	Sportsmen
3	164-166	Nov. 13, 1932	Mouth, Andy Mason Slough, Suisun Bay	Sportsmen
1	172	April 15, 1933	San Pablo Bay	Sportsmen
1	173	June 20, 1933	Point Wilson	Sportsmen
3	174-176	June 22, 1933	Southampton Bay	Sportsmen
4	177-180	Aug. 26, 1933	Antioch Bridge	Sportsmen
1	181	Nov. 24, 1933	Boynston Slough, Suisun Bay	Sportsmen
1	182	Feb. 5, 1933	Suisun Slough	Sportsmen
2	183-184	Sept. 27, 1933	Suisun Slough	Sportsmen
4	185-188	Sept. 28, 1933	Suisun Slough	Sportsmen
1	190	Sept. 28, 1933	Suisun Slough	Sportsmen
10	231-240	Dec. 3, 1932	Between Ryer and Roe Island, Suisun Bay	Sportsmen
10	241-250	Dec. 4, 1932	Grizzly Bay	Sportsmen
5	251-255	Dec. 4, 1932	Between Ryer and Roe Island, Suisun Bay	Sportsmen
5	256-260	May 13, 1933	Beacon, Napa River	Sportsmen
4	261-264	May 19, 1933	Beacon No. 2, Napa River	Sportsmen
6	265-270	June 11, 1933	Steamboat Slough	Sportsmen
2	271-272	Nov. 11, 1933	Middle Ground, Suisun Bay	Division
6	273-278	Nov. 11, 1933	Broad Slough	Division
1	292	July 29, 1933	Tower, Napa River	Sportsmen
8	293-300	Aug. 19, 1933	Tower, Napa River	Sportsmen
1	351	May 27, 1933	Beacon No. 2, Napa River	Sportsmen
16	352-367	May 27, 1933	Tower, Napa River	Sportsmen
12	368-379	May 28, 1933	Tower, Napa River	Sportsmen
1	380	May 29, 1933	Beacon No. 2, Napa River	Sportsmen
1	381	June 10, 1933	Tower, Napa River	Sportsmen
1	383	June 10, 1933	Ratto's Barn, Napa River	Sportsmen
4	384-387	June 11, 1933	Ratto's Barn, Napa River	Sportsmen
1	388	June 17, 1933	Cutting Wharf, Napa River	Sportsmen
1	389	July 1, 1933	Mouth, South Slough, Napa River	Sportsmen
2	390-391	July 4, 1933	Beacon No. 8, Napa River	Sportsmen
19	392-410	July 29, 1933	Tower, Napa River	Sportsmen
4	411-414	Oct. 8, 1933	Beacon No. 2, Napa River	Sportsmen
1	441	Aug. 19, 1933	Tower, Napa River	Sportsmen
47	451-497	Oct. 17, 1933	Broad Slough	Division
58	498-555	Oct. 18, 1933	Point Chipps Island, Honker Bay	Division
54	556-609	Oct. 19, 1933	Point Chipps Island, Honker Bay	Division
6	611-616	Oct. 19, 1933	Point Chipps Island, Honker Bay	Division
14	617-630	Oct. 19, 1933	Broad Slough	Division
21	681-701	Nov. 7, 1933	Off Browns Island, near Pittsburg	Division
1	702	Nov. 8, 1933	Middle Slough	Division
142	703-844	Nov. 8, 1933	Grizzly Bay	Division
42	845-886	Nov. 9, 1933	Grizzly Bay	Division
689				

* Tag No. 70 not used.

It will be noticed from Table I that most of the striped bass were tagged in one general locality, Suisun Bay and adjacent waters. This was due to the fact that fish were more plentiful or at least easier to catch in this region. However, about 50 fish were tagged in Napa River, one fish in San Pablo Bay and about 70 in Broad Slough. All fish tagged were caught by hook and line, the sportsmen usually tagging those that were below the size limit, whereas the Division tagged all fish caught except the very small ones under seven inches.

Table II shows the sizes tagged during the first year and those tagged in October and November of the second year of the work.

The greatest number of fish tagged between September, 1932, and September, 1933, were 11 inches in length, the smallest fish was 5 inches, and the largest 41 inches. There are two groups of sizes, those between 8 and 12 inches and those between 14 and 18 inches, and possibly a third group around 19 and 20 inches. The 8 to 12 inch group is in the main composed of 2 year old fish,* the 14 to 18 inch group 3 year old fish, and the 19 to 20 inch group 4 year old fish. The same groups are also apparent in the fish tagged in October and November of 1933, but the majority tagged were of a slightly smaller size. The proportion of each group to the whole in the fish caught and tagged by the Division in October and November, 1933, is: for the first group about 75 per cent, the second about 23 per cent, and the remainder about 2 per cent. If this proportion represents the true condition of the striped bass population in the bay, and it may, although the material is much too scanty to hazard definite opinion, it is not welcome news for the continuation of good striped bass fishing. If the anglers are drawing heavily on fish from 12 to 18 inches in size and not allowing sufficient numbers to reach maturity at 4 to 5 years of age, the population in a short time may fall alarmingly. Now these "ifs" may or may not be true. There is very little evidence to support them, yet there is some basis as shown by the catch of tagged fish, which were caught with various sizes of hooks and of bait. It is food for thought.

As yet, very little information about striped bass movements is apparent. As said before, 42 tagged bass were recovered, which is 6 per cent of the amount tagged, within a little more than a year's time. A great many of the recoveries were made very near the vicinity where the fish were tagged and liberated. There is no evidence as yet that there is a definite movement of the bass in any direction; the bass that moved any distance moved from their tagging spot in all directions. No conclusions of striped bass movements can be made until more bass are tagged and recovered. The longest movement known was that of two bass which were tagged on the Middle Ground in Suisun Bay and recovered in the Mokelumne River. One bass tagged in Southampton Bay, Carquinez Strait, was recovered at Antioch Bridge. Another recovery was made in San Pablo Bay from the Middle Ground, Suisun Bay. Still another from Napa River was recovered at Toland Landing, Sacramento River.

Table III shows the recovered fish, tag numbers, date and locality of recovery, date tagged, place tagged, size when tagged, and number of days between tagging and capture.

* Scofield, E. C. The striped bass of California. Calif. Div. Fish & Game, Fish Bull., No. 29, 1931.

TABLE II

Total length of striped bass tagged, in inches.	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5
Number tagged during first year:																				
September, 1932, to September, 1933	1		1		4		7	4	21	8	33	23	43	15	38	15	7	4	8	1
Number tagged during second year:																				
October and November, 1933.						3	16	30	54	43	53	37	30	13	16	3	4	2	7	3
Totals.	1		1		4	3	23	34	75	51	86	60	73	28	54	18	11	6	15	4

TABLE II—Continued

Total length of striped bass tagged, in inches.	15.0	15.5	16.0	16.5	17.0	17.5	18.0	18.5	19.0	19.5	20.0	20.5	21.0	21.5	22.0	22.5	23.0	23.5	41.0	Total No.
Number tagged during first year:																				
September, 1932, to September, 1933	10	10	12	4	5	3	4		5	4	1				1				1	293
Number tagged during second year:																				
October and November, 1933.	18	6	16	9	13	1	0	1	1	0	2	2					1			396
Totals.	28	16	28	13	18	4	4	1	6	4	3	2			1		1		1	689

TABLE III

Tag number	Date of recovery	Place of recovery	Date tagged	Place tagged	Size when tagged (inches)	Number of days released before recovery
21	Sept. 25, 1932	Stake Point, Contra Costa County	Sept. 21, 1932	Middle Ground, Suisun Bay	19.0	4
29	Oct. 2, 1932	Bay Point	Sept. 21, 1932	Middle Ground, Suisun Bay	16.0	11
7	Oct. 8, 1932	Seal Isle, Bay Point	Sept. 20, 1932	Middle Ground, Suisun Bay	12.5	18
28	Oct. 23, 1932	Between Bay Point and Pittsburg	Sept. 20, 1932	Middle Ground, Suisun Bay	16.0	32
1	Nov. 23, 1932	Above Sears Point, Napa River	Sept. 20, 1932	Southampton Bay, Carquinez Strait	12.0	63
181	Dec. 1, 1932	Canal Ranch, Mokelumne River	Aug. 27, 1932	Middle Ground, Suisun Bay	15.5	57
93	Dec. 1, 1932	Peytonia Slough	Nov. 24, 1932	Bevinton Slough	41.0	7
63	Nov. 10, 1932	Month, Mokelumne River	Oct. 27, 1932	Middle Ground, Suisun Bay	14.0	14
18	Dec. 15, 1932	Month, New York Slough	Sept. 27, 1932	Middle Ground, Suisun Bay	15.0	52
52	Jan. 2, 1933	Off Chippis Island Ferry	Oct. 27, 1932	Mile above R. R. Bridge, Suisun Bay	15.0	67
154	Jan. 10, 1933	Month, Old River	Nov. 1, 1932	Month, Andy Mason Slough	14.0	57
66	Feb. 9, 1933	Sacramento River, Collinsville	Oct. 27, 1932	Middle Ground, Suisun Bay	10.5	60
160	Mar. 5, 1933	End, New York Slough	Nov. 1, 1932	Month, Andy Mason Slough	19.0	124
4	Mar. 15, 1933	Above Antioch Bridge	Sept. 30, 1932	Southampton Bay	11.0	114
121	Mar. 15, 1933	Above Antioch Bridge	Oct. 28, 1932	Mile above R. R. Bridge, Suisun Bay	10.5	138
275	Mar. 17, 1933	Above Antioch Bridge	Oct. 28, 1932	Middle Ground, Suisun Bay	17.0	126
72	April 5, 1933	San Pablo Bay	Oct. 27, 1932	Middle Ground, Suisun Bay	17.0	160
61	Mar. 20, 1933	Three Mile Slough	Oct. 28, 1932	Avon Wharf, Suisun Bay	12.5	144
135	Mar. 24, 1933	San Pablo Bay	Oct. 28, 1932	Middle Ground, Suisun Bay	13.0	147
49	April 27, 1933	Near Carquinez Bridge	Sept. 21, 1932	Avon Wharf, Suisun Bay	16.0	218
139	April 26, 1933	Month, Middle River	Oct. 28, 1932	Middle Ground, Suisun Bay	13.0	180
87	May 1, 1933	Month, Middle River	Oct. 27, 1932	Middle Ground, Suisun Bay	13.0	186
386	June 25, 1933	Steamboat Slough	June 11, 1933	Ratto's Landing, Napa River	11.0	207
383	June 30, 1933	Beacon No. 2, Napa River	June 11, 1933	Ratto's Landing, Napa River	11.5	14
266	July 2, 1933	Rodeo	June 11, 1933	Steamboat Slough	12.0	20
31	July 13, 1933	Head, Steamboat Slough	June 11, 1933	Steamboat Slough	11.0	22
76	July 4, 1933	Isleton, Sacramento River	Sept. 21, 1932	Middle Ground, Suisun Bay	17.0	264
*231	Aug. 20, 1933	Torney	Sept. 27, 1932	Middle Ground, Suisun Bay	15.0	245
396	Aug. 20, 1933	Mile above Collinsville	Dec. 8, 1932	Ryer and Roe Island	8.0	260
236	Sept. 22, 1933	Toland, Sacramento River	July 28, 1932	Tower, Napa River	12.0	22
116	Sept. 22, 1933	Pittsburg	Dec. 8, 1932	Ryer and Roe Island	9.0	292
116	Sept. 22, 1933	McAvooy	Dec. 8, 1932	Ryer and Roe Island	10.5	329
26	Feb. 15, 1933	Rodeo	Oct. 28, 1932	Middle Ground, Suisun Bay	15.5	160
146	Feb. 15, 1933	Rodeo	Oct. 28, 1932	Avon Wharf, Suisun Bay	12.0	123
98	Feb. 15, 1933	Rodeo	Oct. 28, 1932	Middle Ground, Suisun Bay	20.0	124
179	Oct. 15, 1933	Broad Slough	Aug. 26, 1933	Autioch Bridge	10.0	50
300	Oct. 15, 1933	Middle Ground, Suisun Bay	Aug. 19, 1933	Tower, Napa River	11.0	58
272	Oct. 18, 1933	Off Bay Point	Nov. 11, 1932	Middle Ground, Suisun Bay	17.5	341
*400	Oct. 11, 1933	Steamboat Slough	July 29, 1933	Tower, Napa River	8.0	74
106	Oct. 15, 1933	Mile east of Antioch	Oct. 28, 1932	Off Stag Island	10.5	354
454	Oct. 22, 1933	Sacramento River, Pittsburg	Oct. 17, 1933	Broad Slough	16.5	5
*477	Nov. 2, 1933	Sacramento River, Pittsburg	Oct. 17, 1933	Broad Slough	7.0	16

*Fish recovered, tag recorded and fish liberated again with tag still attached.

As shown in Table III, the shortest period of time a tagged bass was out was four days and the longest was 354 days, though of course there are a great many fish still at large. There seems to be no relationship between the size of fish and the length of time before recovery: however there is some evidence that fish 14 to 18 inches in length were recovered in greater proportion than the smaller sizes, considering the larger numbers of small fish tagged.

The foregoing is in the nature of a progress report of striped bass tagging. The material at hand, number of fish tagged and recovered, do not afford sufficient data on which to base conclusions on the movements of striped bass. It is therefore urged that the sportsmen increase interest in the work and tag more bass in order that we may be able to trace the movements of the stripers with some degree of certainty.

OCTOPI OF CALIFORNIA *

By J. B. PHILLIPS

From time immemorial it has been customary for the layman to apply the term "devil" to animals that have a fearful appearance or to animals to which the power of creating evil has been attributed. It is not surprising that the term "devil" has been applied to the octopus in view of its long, snaky, writhing arms covered with numerous suckers, and the soft, muscular body with sinister-looking eyes. This apprehensive appearance has been heightened by various tales woven around a very few facts. Altogether, the term "devilfish" is misleading as it is subject to local or personal interpretation, whereas the term octopus in this particular case is a descriptive and universally accepted name.

POPULAR DESCRIPTION OF COMMON OCTOPUS

Briefly an octopus may be described as an invertebrate marine animal having a large head and a small sac-like body above eight arms that are more or less united at the base by a membrane. The arms are usually provided with two rows of suckers by means of which they cling to rock or prey. Ordinarily, the octopus lives on the bottom along a rocky coast and moves on and off shore amongst the rocks in search of food. In times of danger, it retreats into the openings and recesses among the rocks. The octopus breathes by taking in oxygen-laden water through a slit in the neck portion of the body. This water passes over feather-like gills in the body cavity and is forced out through a funnel-like siphon that is visible on the right side of the neck portion. Locomotion is accomplished in two different ways. When frightened, the octopus can rocket itself backward by a series of sudden contractions of the body, rapidly taking in and expelling jets of water. Ordinarily, the octopus moves about on the bottom by lengthening and contracting its eight muscular arms. Loss of an arm only inconveniences it temporarily as it can grow another.

The octopus is somewhat of a scavenger as well as a fresh flesh eater. It shows particular liking for rock crabs which it stalks and drops on from above. Several crabs can be held at one time and are eaten by tearing off the legs and getting to the soft inner parts from the under side. A pair of chitinous beak-like jaws, situated within the mouth of the octopus, is an aid in such cases. The octopus also feeds on abalones and mussels. Abalone divers tell of occasionally finding an octopus patiently exerting pressure on an abalone. The abalone eventually tires and relaxes, even as an oyster gives in to a starfish. The octopus can also open mussels in a similar manner. The powerful grip of the octopus is due to the vacuum created by lifting up the floor of the sucker, while the rim of the sucker is attached, and then dropping the floor.

* Contribution No. 137 from the California State Fisheries Laboratory, November 8, 1933.

OCTOPUS AS FOOD

Strange as it may seem to some, the octopus is considered a food delicacy by certain people in America, mainly Japanese, Chinese, Italians and Greeks. Present day gastronomical acceptance of octopus by these people may be traced back to the ancient Romans and Greeks, who considered it the finest "fish" in the sea. Gourmands of Rome ate with relish every species of octopus caught in the Mediterranean Sea. These they baked in a sort of big pie, cutting up the arms and filling the head with spices.

The usual method of preparing octopus for the table by present day connoisseurs is to cook it in boiling salted water twenty to thirty minutes. The animal is first dipped in the boiling water a few times as an aid to loosening the skin. After boiling, the animal is skinned, cut into pieces and served with a vinegar sauce. For particular flavor, some Italians add tomatoes and garlic while boiling. Before cooking, the arms of an octopus might be pounded to loosen up the muscular fibres. An aid to cleaning an octopus is to turn the mantle inside out at the neck portion.

COMMERCIAL IMPORTANCE

The commercial octopus fishery of California is of minor importance. Since 1920, the annual catch has varied from 10,000 to 165,000 pounds, with about 75,000 pounds as the usual yearly landing. Of the total annual State poundage, 85 per cent (all *Polypus hongkongensis*) is delivered at the two Monterey Bay ports: Monterey and Santa Cruz. Monterey deliveries are the greatest in the State, comprising 65 to 70 per cent of the annual State catch. Next to Monterey, the ports of largest deliveries are Santa Cruz and San Francisco. During the past few years, San Francisco has surpassed Santa Cruz. Monterey, however, holds its place by a wide margin. Within the past few years, landings of Sonoma and Mendocino counties have increased and rival those of San Francisco and Santa Cruz. Los Angeles, the only other port of consequence, normally receives a few hundred pounds a year.

METHODS OF CAPTURE IN CALIFORNIA

At Monterey and along the California coast in general, octopi are captured, for the most part, in cage-like baited traps set close to the rocks. The so-called "devilfish" or octopus trap is constructed as a wire screen box or a wicker basket. The most widely used trap is the wicker basket, similar to the one pictured in Fig. 4. These traps are 4 to 5½ feet high and about 2½ to 3 feet in diameter at the large (mouth) end. A trap-door is located at the small end of the trap, opposite the large end, and is for baiting the trap and extracting the catch. There is but one mouth, which is in the form of a funnel at the large end. This funnel is about 2 feet long and starts with the circumference of the large end. It tapers to about a 6-inch opening in the center of the trap. Most traps of this type are constructed of rattan with a few wires around the circumference for reinforcement. The rattan is better than an entirely wire construction because of its flexibility when in contact with rocks.

In southern California, a box-like trap covered with chicken wire is used more commonly. This trap is not set in very deep water as the species of octopus most common there is smaller and inhabits comparatively shallow water.

At Monterey, there are two and sometimes four octopus fishermen, all Italians. These fishermen have 10 to 30 traps apiece. The traps



Fig. 4. An octopus trap such as is used at Monterey. This trap is 4 feet high and is constructed mainly of rattan. Note funnel terminating in small opening in middle of trap. The large end resting on ground is the mouth of the funnel. Specimens of prawn accidentally caught in trap are being exhibited. Photo by Joe Wales, November, 1900.

are baited and anchored one-half to one mile from shore in series of about 10 traps. The main fishing locality is off the rocky shores of the open coast between Point Pinos and south to Carmel, in 10 to 30 fathoms of water. The traps are looked after each day or two in connection with other fishing. The yield during a normal season (spring,

summer and fall months) is probably an average of 15 octopi a week from a set of 10 traps. The number of deliveries per week and the amounts delivered fluctuate a great deal. On one occasion, during the last summer, 400 pounds of octopi averaging 25 pounds apiece were brought in by a fisherman after one trip. The octopi delivered at Monterey average 20 to 30 pounds each. A record specimen weighed 90 pounds. During the winter months, few octopi are delivered because of the unsettled water conditions along the coast. The price paid fishermen may range from 5 cents a pound in the summer to 15 cents a pound in the winter, depending upon abundance.

The reason more fishermen do not take up octopus fishing is that a few fishermen can supply the demand. Furthermore, the return per unit of gear is slight and a set of 10 to 12 traps, plus ropes, anchors, etc., costs about \$100. A string of traps may be easily lost when set off an open coast, especially in times of rough water.



Fig. 5. A typical jig boat at Monterey. This boat is about 30 feet long and has a 12-horsepower gasoline engine. Octopus fishing is carried on by a very few fishermen, in connection with other market fishing. Note octopus trap, similar to one pictured in Fig. 4, being repaired on deck. Photo by J. B. Phillips, May, 1933.

As octopus traps are operated in conjunction with hand line and similar market fishing, the jig type of boat is used in the operations. The jig boats at Monterey are 25 to 35 feet long and have gas engines of 8 to 16 horsepower. Fig. 5 shows a typical type of boat with a trap being repaired on deck.

METHODS OF CAPTURE IN OTHER COUNTRIES

Bartsch (1931) has published some interesting accounts of methods that other people use in capturing octopus. The simplest method of capture, according to him, is probably that used by Filipinos. On a dark night, a band of Filipinos wearing only "G-strings," form a ceremonial procession to the sea. In one hand they bear lighted torches and in the other, spears. The light of the torches penetrates the shallow water and reveals the luckless octopus, which apparently forsakes the

secure caverns of the reef and goes hunting for food in the shallow flats near shore, where it is easily speared.

On the island of Guam, Bartsch tells about an entirely different procedure. The natives work on the inside of reefs, in the surf. They use large repulsive-looking sea cucumbers tied to a line with a sinker which is lowered among the crevices of the reef. The first action of the sea cucumber is to try to hide, and if he finds a cavity containing an octopus, the latter at once moves out and is easily speared from the canoe. Evidently, the company of the sea cucumber is quite distasteful to the octopus.

Bartsch quotes Dr. H. M. Smith on Japanese methods in the following vein: Octopi are an abundant and important food product in Japan. This cephalopod is caught in various ways, the most interesting of which is by the use of earthenware pots, which are lowered to the bottom by means of cords and left for 8 to 10 hours. The octopi enter the shiny, smooth pots and are evidently reluctant to leave, so that the pots may be pulled to the surface before they try to escape. These pots have a hole in the bottom to allow the escape of water.

Dr. Smith goes on to tell of a reverse procedure of this method in recovering valuable porcelains destined for the Imperial household from a vessel that was wrecked in the Inland Sea about a century ago. Fishermen have recently been recovering these valuable pieces of pottery, which are in excellent condition, by tying strings to octopi and lowering them in the vicinity of the wreck. The animals enter the vessels and retain their hold until drawn to the surface.

ANIMAL KINGDOM RELATIONSHIP

The octopus is not related to fishes. All animals can be separated into two groups known as invertebrates and vertebrates, that is, with or without a backbone. True fishes belong to the latter group (vertebrate), while octopi belong to the former group. Those animals having certain structural characters in common are placed in smaller groupings called phyla. For example, octopus and squid belong to the phylum Mollusca. Although this phylum also includes such external shell-bearing marine forms as abalones, clams, scallops and mussels, all animals of this phylum have in common a mantle, a ventral muscular foot, as well as a shell, or a vestige of one, and a radula. In the case of abalones, clams, etc., the shell is external, whereas in squids it is reduced to a chitinous inner pen or cuttlebone, and in the octopus to an insignificant coiled vestige.

However, the squids, octopi and nautilus differ from other members of the phylum Mollusca in that the foot is divided into arms provided with suckers (as well as a strongly developed nervous system concentrated in the head), so that they are grouped together in the class Cephalopoda, meaning "head-footed."

The Cephalopoda are divided into two orders, Tetrabranchia and Dibranchia. The order Tetrabranchia is characterized by the presence of four gills, four kidneys, four auricles, a large external shell, and very short arms bearing no suckers. The only representative of this order is the genus *Nautilus*, to which belongs the chambered or pearly nautilus. The order Dibranchia is characterized by the presence of only two gills, two kidneys, two auricles, a shell enveloped by a mantle, and long arms provided with suckers.

The order Dibranchia in turn is divided into two suborders called Decapoda and Octopoda. The Decapoda are mainly differentiated by the presence of ten arms, eight short and two long. The arms bear suckers and sometimes hooks. The group includes the squids and cuttlefish. The Octopoda are mainly distinguished by the presence of but eight sucker-bearing arms of equal length. The suborder includes the octopus and the paper nautilus or argonaut.

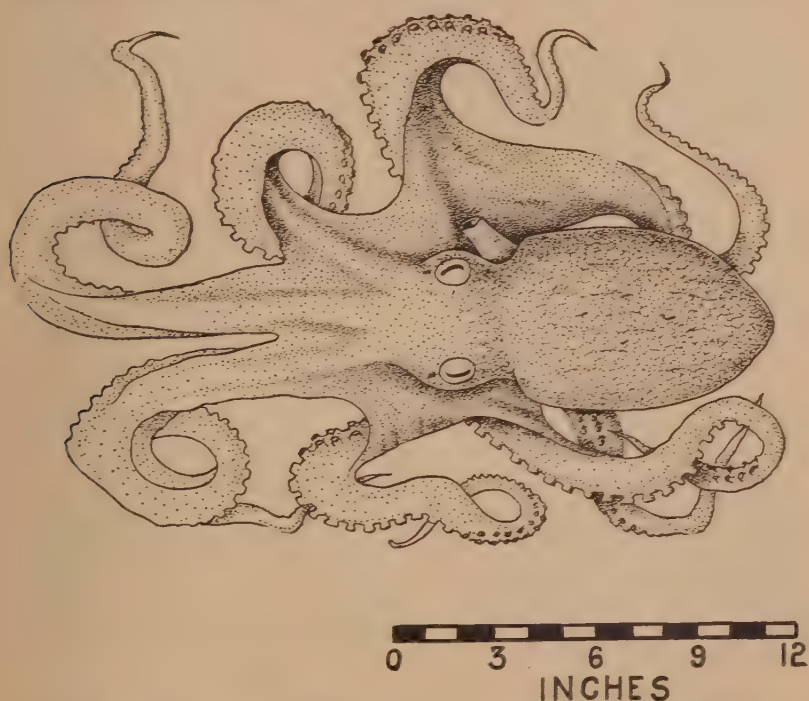


Fig. 2. Octopus (*Polypus hongkongensis*). Drawing by Dr. Harold Heath.

SPECIES OF OCTOPI REPORTED ALONG CALIFORNIA COAST

There are some half dozen species of octopi found along the coast of California. Most species are found in southern waters but the largest and most abundant form is more northern in distribution. There are but two forms that appear in any numbers along our Pacific coast. These are the big octopus (*Polypus hongkongensis*), which attains a total expanse of about 16 feet and is found from Alaska to San Diego on this side of the Pacific and from China northward on the Asiatic side; and the two-spotted octopus (*Polypus bimaculatus*), which attains a length of about 20 inches and is found from San Pedro, California, south to Panama.

Following is a brief description of the octopi found along the California coast, as adapted after Berry (1912):

Polypus hongkongensis.—This is the big octopus that represents practically the entire commercial catch in California. It has a wide

distribution, being found on the coasts of China and Japan as well as on our coast from Alaska to San Diego. It is an abundant shore form and reaches a length of 16 feet and a weight of 90 pounds. The usual weight of specimens landed at Monterey is 20 to 30 pounds.

The body is short and almost globular, and the arms are stout and very long. The head is rather small, being separated from the body by a slight constriction. Fairly prominent eyes are located on the top sides of the head. The funnel is long and conical, terminating as usual along the right side of the head. The suckers are largest where the arms join the umbrella, diminishing rapidly in size near the tips of the arms. The surface of the body is somewhat tuberculated, and the color is milky whitish or translucent grayish, the outer surface being overlaid with blackish, brownish or purplish dots.

Polypus bimaculatus.—This is the two-spotted octopus, the common shore octopus of southern California. Purplish ocular spots in front of the eyes are a distinguishing feature. The spots are large, round and decidedly darker than the rest of the animal. The body and arms are similar to those of *P. hongkongensis*. Numerous warty papillae cover the surface of the body, varying from a nearly smooth state to very rugose. A large conical, warty projection is present just over each eye.

The distribution of this octopus might be said to start where the big octopus leaves off. It is found from San Pedro southward to Panama. It is taken mainly from tide pools at low tide. Large specimens measure about 20 inches in length.

Polypus californicus.—Only a few specimens of this species have been reported and these were taken off San Diego. The body is of moderate size, short, rounded and compact. The arms are stout and moderately long, the basal portions being about one-fourth webbed. The main distinguishing features are the numerous large star-like papillae that cover the surface of the body, becoming nearly obsolete ventrally. Also, above each eye is a rounded flattened tubercle, slightly larger than the rest.

Polypus gilbertianus.—This species is also rather uncommon and is reported only from southern California. The body is of moderate size and is a little broader than long. The surface is covered everywhere with numerous minute, rough papillae, giving the skin a somewhat grainy texture. A large softened, flattened, blunt tubercle is present above and slightly behind the center of each eye. The eyes are somewhat large and rather protruding. The funnel is broad at the base, tapering to nearly cylindrical at the extremity. Arms are rather long and slender, being webbed by the strong umbrella for about one-fourth of their length, the membrane continuing from the umbrella to nearly the tips of the arms.

Elodonella heathi.—This is another uncommon octopus from southern California waters. The body is of moderate size and the skin is smooth in contrast to the four forms just described. The arms are slender, the third pair being much the longer; suckers in a single row; umbrella extending to about one-third of arms. The head is short, broad and greatly compressed above and below, and is well separated

from the body. The eyes are very large, with protruding lenses. The funnel is broad and thin, not extending to eyes.

Cirroteuthis macrope.—This is a rare species previously only reported from San Diego. In September, 1932, a specimen taken by Santa Cruz fishermen was sent by Louis Beverino to Mr. D'Acquisto of Monterey, who brought it to Dr. Rolf Bolin of the Hopkins Marine Station (Stanford University). The distinctive feature of this species is that the umbrella is attached nearly to the tips of the arms, giving a truly umbrella-like appearance. This species is rather small and subgelatinous in consistency. The body is somewhat barrel-shaped and fairly elongate with short broad oar-like fin on either side near the posterior extremity. The head is wide, flattened and broadly continuous with the body above. The left eye is larger and more protruding than the right. The funnel is large, broad and well-imbedded.

Argonauta pacifica.—This is the pelagic form, commonly known as the "paper nautilus" (not chambered or pearly nautilus) and is found from Monterey, California, to the equator. It is of moderate size, the male being much smaller than the female. In the male, the third arm of the left side is entirely modified into the form of an oval sac for reproductive purposes. In the female, the tips of the dorsal arms are greatly expanded, wing-like, and their function is to secrete the large fragile "shell" or egg case. The coloration of this octopus tends to orange with fine purple dots, more crowded and larger on the back.

Polypus leioderma.—This form is reported only from Alaska by Berry. It can be readily recognized by the narrow and distinct keel-like fold of integument that bounds the body laterally. The body is of moderate size, wider than long, and nearly smooth except for a few simple papillae on the dorsal surface. The head is short with large protruding eyes. The arms are not very long; the umbrella extending between dorsal and ventral arms for over one-fourth of length but much shorter between ventral pairs.

OCTOPUS TALES OF OLDEN TIMES

A review of some of the literature of ancient times bearing on octopi reveals some very interesting stories that were supposed to be scientifically correct. These stories, which were written evidently as truthful accounts, put to shame much of our present day fiction, which is taken for granted as being based on little or no fact.

Bartsch (1917), in his research for the Smithsonian Institution, has published a collection of ancient facts and fancies about cephalopods (squid and octopi), from which the following are taken:

One ancient writer told of an octopus that was in the habit of coming from the sea to feed on salted fish packed in pickling tubs, some distance from shore. Repeated forays prompted the owners of the operations to place a high fence between the works and the sea. However, the octopus surmounted this fence with the aid of a tree, and it was only caught by calling dogs to their aid. The dogs surrounded the marauder but were kept at bay by the terrible stench exuded by the animal and the eight arms which whipped out at the dogs. It was finally killed with three-prong spears. This octopus was reported as weighing 700 pounds, and having suckers as large as urns.

Another story is about an octopus considered dead and placed in a kettle hung over a fire. This particular octopus became sufficiently revived to leave the kettle, climb up the chimney and onto the roof, where after considerable hunting it was discovered hiding behind the chimney.

Statements are also made that natives of the Sudian Isles, when sailing in canoes, always provided themselves with hatchets so that they could immediately cut off the arms of these animals if they happen to be flung over the sides, lest the boat be pulled under water.

The captain of an African slaver on the west coast of Africa recounted the story of a monstrous cuttlefish (a painting of this animal and ship, however, proved the animal to be an octopus of immense proportions) that appeared on top of the water and slung its arms about two of the masts. The weight of this cephalopod dragged the ship over on its side and would have capsized it except for the promptness of members of the crew, who cut off the arms with an axe. This was not accomplished without renewed courage that was instilled into the crew by a prayer to a certain patron saint.

The writings of these ancient peoples have evidently influenced our earlier modern writers. Bartsch reproduces a drawing from an early issue of the *San Francisco Chronicle*, which shows a combination crab and octopus some 100 feet long. The artist not only drew claws on the ends of every one of the eight arms, but enthusiastically modified the body into huge claw-like jaws bearing some sort of large saw-like teeth.

MODERN VERSIONS

Painstaking workers have slowly revealed that these legends and myths have been woven around greatly distorted facts. Ordinarily, the octopus can be considered a timid and inoffensive creature. It is probable, though, that on occasions a large octopus may entwine itself around a person's limb, when the rest of the body is hidden, so that the octopod is led into believing that the limb is legitimate prey of some sort. This must occur, however, in the natural habitat of the octopus, which is usually at some depth along rocky shores or reefs. Authentic cases of an octopus causing death by drowning or by some other manner are hard to find.

Japanese abalone divers, working to a depth of 100 feet, along the same strip of coast (Monterey, California) where octopus are trapped for market, do not complain of attacks by this eight-armed cephalopod. Occasionally, if they are fortunate, one is cornered and a line is tied around the body so that it can be hoisted to the surface, whence it forms the main course of a meal some time later.

However, Mr. Oscar Lager, a diver now making his home in Monterey, who has had 16 years of experience as an all round diver from Alaska to Mexico, has a different opinion about this subject. Mr. Lager has been down to a depth of 187 feet and claims to have had several encounters with octopi and other sea animals, which he does not care to repeat. He is emphatic in his assertion that large octopi are treacherous, especially those of the South Seas.

There may be a few authentic cases of encounters between fishermen and divers and octopi, but in general the octopus need not be considered a dangerous animal.

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PREDATORY ANIMAL STUDIES

By DONALD D. McLEAN

INTRODUCTION

This predatory animal study program in the State game refuges was started on the first of January, 1932. This report covers the period from that date to June 30, 1933. Beginning July 1, 1933, it was found necessary through lack of funds to reduce the number of trappers to four.

Because definite information regarding the food of predators was lacking, it was arranged to examine the stomachs of all animals and to positively identify the contents. The Stanford University Museum kindly furnished working space, and their collection of birds and mammals for reference in the determination of contents proved invaluable.

Coyotes and bobcats were the primary species included in this study, although when other species were trapped their stomachs were preserved for study. Refuge areas on which trapping was conducted were reported to be heavily stocked with both coyotes and bobcats. Trappers were required to make daily reports on the number of traps out, miles of trap line, number of animals caught, weather conditions, and number and species of game seen. Maps showing trap lines, location of settings, and location and elevation where each animal was caught, were also required. Other information which they could give from personal observation was included in the reports.

Much data pertaining to the range, number and habits of coyotes and bobcats at various seasons, on these areas, was secured.

<i>Trapper</i>	<i>Size of areas trapped</i>
J. N. Ray	Game Refuge 3B, San Benito Co., 21 sq. mi. plus 61 sq. mi., totaling 82 sq. mi. Elevation 950 feet to 3287 feet.
Shaw	Game Refuge 1O, El Dorado Co., 118 sq. mi. Elevation 2200 feet to 7285 feet. Part of game refuge 1J, Amador Co. 15 sq. mi. Elevation 5500 feet to 8000 feet. Part of Game Refuge 1I, Placer Co., 21 sq. mi. Elevation 1700 feet to 8400 feet.
R. Ray	Game Refuge 1M, Kern Co., 116 sq. mi. plus 26 sq. mi., totaling 142 sq. mi. Elevation 2000 feet to 7544 feet. Game Refuge 1K in Fresno Co., 59 sq. mi. plus 61 sq. mi., totaling 120 sq. mi. Elevation 1000 feet to 10,044 feet. Los Banos Waterfowl Refuge, Merced Co., approximately 5 sq. mi. plus 2 sq. mi., totaling about 7 sq. mi. Valley conditions. Elevation 90 feet. Gray Lodge Waterfowl Refuge, Butte Co., approximately 4 sq. mi. plus 1½ sq. mi., totaling about 5½ sq. mi. Valley conditions, elevation 60 feet.
McDonald	Game Refuge 2A in Lake, Mendocino and Glenn Cos., 60 sq. mi. plus 41 sq. mi., totaling 101 sq. mi. Elevation 3000 feet to 6954 feet.
Willburn	Game Refuge 1D, Trinity Co., 104 sq. mi. Elevation 2800 feet to 6262 feet.
Powell	Game Refuge 1R in Tuolumne Co., 151 sq. mi. Elevation 1600 feet to 7500 feet. Game Refuge 3E, Santa Clara Co., 6 sq. mi. plus 4 sq. mi., totaling 10 sq. mi. Elevation 2250 feet to 4209 feet.
Munneke	Game Refuge 1G in Tehama Co., 169 sq. mi. plus 24 sq. mi., totaling 193 sq. mi. Elevation 1000 feet to 5500 feet. Game Refuge 1F in Lassen Co., 75 sq. mi. plus 4 sq. mi., totaling 79 sq. mi. Elevation 5100 feet to 7000 feet. ¾ of Game Refuge 3D, Ventura Co. plus 72 sq. mi., totaling 133 sq. mi. Elevation 950 feet to 6300 feet.

Trapper	Size of areas trapped
Wallace	Half of Game Refuge 4A, San Bernardino Co., totaling 280 sq. mi. Elevation 2000 feet to 11485 feet. Also on the quail refuges at Los Flores and Talmadge in that district.
Williams	Game Refuge 4E, San Diego Co., 81 sq. mi. Elevation 3000 feet to 5000 feet.

CATCH DATA

	Coyote	Bobcat	Skunk	Fox	Coon	Opos- sum	House cat
J. N. Ray	175	117	52	29	31	5	4
Shaw	68	19	34	7	1	--	--
R. Ray	80	70	22	14	3	1	14
McDonald	26	44	32	33	43	--	--
Willburn	10	5	4	15	--	--	--
Munneke	102	31	34	32	6	9	4
Powell	22	22	35	9	9	1	--
Wallace	63	20	90	15	2	2	--
Williams	17	41	17	57	4	--	--
Totals	563	369	320	211	99	18	22

	Badger	Ringtail cat	Bear	Mink	Weasel	Mountain lion
J. N. Ray	20	--	--	--	--	--
Shaw	--	--	--	--	--	--
R. Ray	1	--	--	2	3	1
McDonald	--	11	5	19	--	1
Willburn	--	--	1	--	--	5
Munneke	4	--	--	--	--	--
Powell	2	--	--	--	--	--
Wallace	1	--	--	--	--	--
Williams	--	2	--	--	--	--
Totals	28	13	6	21	3	7

932 coyotes and bobcats
1680 total number of animals

The following tables apply to coyotes and bobcats only:

MILES PER ANIMAL

	Total No. miles of trap line	No. of coyotes	Miles per coyote	No. of bobcats	Miles per bobcat	Total No. animals
J. N. Ray	18,500	175	105.7	117	158.1	292
Shaw	6,419	68	94.4	19	337.8	87
R. Ray	11,419	80	142.7	70	163.0	150
McDonald	9,932	26	382.0	44	228.8	70
Willburn	1,347	10	134.7	5	269.4	15
Munneke	10,971	102	107.5	31	353.9	133
Powell	7,118	22	323.7	22	323.7	44
Wallace	3,395	63	53.9	20	169.7	83
Williams	2,592	17	152.5	41	63.2	58
Totals	71,693					932

SETS PER ANIMAL

	Total No. of sets	Sets per coyote	Sets per bobcat	Sets per animal
J. N. Ray	16,872	96.4	145	57.7
Shaw	13,263	195.0	698	152.8
R. Ray	12,630	157.8	180.4	88.9
McDonald	13,673	526.0	310.7	195.7
Willburn	3,958	395.8	791.6	264.0
Munneke	10,902	106.8	351.7	82.7
Powell	12,570	571.4	571.4	285.7
Wallace	4,757	75.5	237.8	54.7
Williams	2,297	135.1	56.0	39.7
Total	90,922			

77 miles per animal for the group
97.5 sets per animal for the group

COST DATA

	Days	Salary	Coyotes	Bobcats	Miles	Sets	Days per animal	Cost per animal
J. N. Ray----	539	\$1,800 00	175	117	18,500	16,872	1.8	\$6 16
Shaw -----	511	1,790 32	68	19	6,419	13,263	5.9	20 60
R. Ray -----	476	1,790 32	80	70	11,419	12,630	3.3	11 93
McDonald ----	540	1,790 32	26	44	9,932	13,673	7.7	25 57
Willburn ----	187	650 00	10	5	1,347	3,958	12.2	43 33
Munneke ----	395	1,548 39	102	31	10,971	10,902	2.9	11 64
Powell -----	421	1,500 00	22	22	7,118	12,570	9.6	34 05
Wallace ----	232	1,480 00	63	20	3,395	4,757	2.8	17 83
Williams ---	183	750 00	17	41	2,592	2,297	3.2	13 00
Totals-----	3,484	\$13,099 35	563	369	71,693	90,922		

Each animal cost----- \$14 05

Number of days per animal, 3.73

RECORD OF STOMACH EXAMINATIONS

Predators' stomachs to the number listed below contained the particular items mentioned:

Coyote—537 stomachs		Skunk—133 stomachs	
297 empty		95 empty	
240 with contents		38 with contents	
100 deer	45 ground squirrel	28 insects	1 pine squirrel
2 quail	40 cow	2 lizard	1 cow
13 bird	24 sheep	7 mice	1 junco egg
78 rabbit	5 hog	2 deer	1 wood rat
11 mouse	7 chicken	4 bird	1 ground squirrel
6 wood rat	7 gray squirrel	6 rabbit	
8 gopher	3 kangaroo rat		
2 insects	1 goat	Coon—59 stomachs	
3 lizard	1 antelope	39 empty	
		20 with contents	
Bobcat—324 stomachs		1 snake	1 duck
168 empty		8 insects	1 grebe
156 with contents		6 frogs	1 rabbit
13 deer	17 ground squirrel	3 mice	2 berries
5 quail	2 chicken	2 bird	1 garbage
34 bird	9 gray squirrel	Fox—152 stomachs	
24 rabbit	8 gopher	101 empty	
31 mice	1 house cat	51 with contents	
35 wood rat	1 skunk	8 bird	2 quail
1 insect	1 sheep or goat	5 insects	1 ground squirrel
1 lizard		10 berries	1 chicken
		30 mice	1 kangaroo rat
		5 rabbit	1 lizard
		1 cow	1 deer
		2 wood rat	

DEER REMAINS IN COYOTES BY MONTHS

1932	Male	Female	1933	Male	Female
January -----	1	2	January -----	1	5
February -----	2	1	February -----	1	1
March -----	-	-	March -----	2	1
April -----	4	3	April -----	3	-
May -----	3	3	May -----	4	2
June -----	1	3	June -----	-	2
July -----	2	1			
August -----	4	2			
September -----	5	7	Totals-----	53	47
October -----	7	2			
November -----	4	5			
December -----	9	7			

RANGE OF COYOTES AND BOBCATS

In refuge 3B in San Benito County during the first three months of the year, most of the coyotes were taken between 1200 and 1500 feet elevation, and during the next seven months at about the 2000-foot level. In November and December they were back down to the 1700-foot level.

In refuge 1-O in El Dorado County from January to May most of the coyotes were taken near the 4000-foot line. During June and July they had moved up to about 4500 feet. November and December, before the heavy storms, found most of them at the 6000-foot level.

In refuge 1J in Amador County, during the month of October, all coyotes were taken between 5300 and 6500 feet altitude.

During the months of August and September in refuge 1-I in Placer County, coyotes were taken near the 5000-foot contour.

On refuge 1G in Tehama County few coyotes were caught possibly on account of heavy trapping in the foothills to the west by private trappers.

On refuge 2A in Lake, Mendocino and Glenn counties there was little shifting of the coyote population. Few were taken above the 3500-foot contour.

One interesting thing pertaining to the range of coyotes was noted in 1-O in El Dorado County. On Big Silver Creek and its middle fork, 23 miles of trap line was run for a considerable period of time when deer were plentiful in the area without a single coyote being caught. They did not come into the area during the entire summer.

Certain refuges appear to be in the concentration areas of coyotes. Refuges 1F in Lassen and 3B in San Benito are so situated. Both of these refuges are in sheep grazing areas. In 1F the coyotes left when the sheep were driven out, which was about a month before the deer went to their wintering ground. In 3B there were plenty of coyotes throughout the year but the sheep remained also. Other refuges, although well supplied with game and other food but harboring no sheep, did not have coyotes in such numbers.

The area over which a resident coyote will range is not as large as might be supposed. It is a circuit covered at intervals of several days, each day covering an area about five miles square. The female coyote during the pupping time has a short range; at other times it is about the same as the male.

I have only two definite records where coyotes were seen killing deer. In El Dorado County, in snow about $3\frac{1}{2}$ feet deep, a deer was killed by a coyote and in San Benito County three coyotes had killed a doe. In the last instance one coyote was ham stringing the doe while the other two were working from the sides near the head. They all came down a steep slope together and finished her in the creek bed.

Bobcats range below 5000 feet, which is the approximate upper limit of the heavy brush region. A few are found in the timber area. These are mostly wandering males. They were caught at all seasons and elevations in 3B. In 1-O, 1J and 1-I they were scarce as most of these refuges are above the average bobcat range.

In refuge 1G few bobcats were found in the refuge, but just outside its western boundary at a lower elevation they were fairly

plentiful. In refuge 2A the average elevation of capture was 3100 feet.

Squirrels and rabbits are the principal food of the coyote while the wood rat is the mainstay of the bobcat. Both animals eat carrion but the bobcat does so to a much less degree. Coyotes gnaw on carcasses from the time they are fresh until nothing but hide and bones remain.

In the San Benito County refuge and vicinity during the hunting season for deer and the month following, 7 coyotes had eaten deer. During the other 15 months the trapper was operating, only 11 had eaten deer. Thirty-nine per cent of the coyotes that had eaten deer did so in one-sixth of the time the trapper was working. This would indicate that the hunter is of considerable help to the coyote. Wounded deer, hides, legs, heads and other remains thrown away by the hunter are very acceptable to the hungry coyote.

In refuges in the northern Sierras where heavy winter conditions prevail, the findings are not the same as in the Coast Range. Only three coyote stomachs of those trapped in the hunting season contained deer remains. However, during the two winters the trapper was operating, there was a heavy loss of deer on account of deep snows. When the carcasses of these deer were available in the late winter and spring, deer remains showed up in almost all the stomachs. Heavy winters are good for the coyote but hard on deer.

Of the 537 stomachs examined, 240 contained food and of that number 100 or 41 $\frac{2}{3}$ per cent contained deer meat, bones, hair or other parts; 27 per cent of the 100 were taken during and in the month following deer season; 30 per cent of the 100 were taken in the winter deer kill area, leaving 43 per cent for other times of the year. It is possible that the first kill is made by some other agency (mountain lions kill over 30,000 deer a year in California) and that the coyote, at this time of the year, is a second feeder. Only two coyote stomachs contained hair of young fawns during the time spots were present. These were both taken in San Benito County.

SUMMARY

In San Benito County it required 18,500 miles of trap line and 16,872 sets to take 175 coyotes in 17 months. An average of 105.7 miles of trap line and 94.6 sets for each animal.

In Lake County coyotes were not so numerous. In 18 months time only 26 coyotes were taken on a trap line of 9932 miles with 13,675 sets. An average of 382 miles and 526 sets per animal.

In El Dorado County in 18 months time with 6412 miles of trap line and 13,263 sets, 68 coyotes were taken. An average of 94.4 miles and 195 sets per animal.

In San Diego County in 7 months time, by running 2592 miles of trap line and 2297 sets, 17 coyotes were caught. An average of 152.5 miles and 136.1 sets per animal.

In Lassen County in three months with 2585 miles of trap line and 1272 sets, 51 coyotes were taken. An average of 50 miles and 25 sets per animal.

In Kern County during 10 months, with 8604 miles of trap line and 7414 sets, 52 coyotes were taken. An average of 165.6 miles and 142.5 sets per animal.

In Trinity County during $6\frac{1}{2}$ months time on 104 square miles, 1347 miles of trap line was run to capture 10 coyotes or an average of one coyote to 10.4 square miles; and one coyote to 134.7 miles of trap line. A total of 3958 sets were exposed or an average of 395.8 sets per coyote.

This summary shows something of the relative abundance of coyotes in the various refuges.

Bobcats were most numerous in San Benito and Lake counties. In the Coast Range, coyotes and bobcats are practically resident wherever found, not migrating perceptibly. In the Sierras the seasonal migration of coyotes is east and west. The summer resident coyotes at high elevations drop down replacing those at a lower level, which in turn move down replacing others until there is a greater or less movement into the valleys. This migration begins at approximately the time sheep are moved from their summer range. The upward migration follows the receding winter and possibly the spring herding of sheep to the summer range. After winters of heavy snow in which many deer are killed, these coyotes find a bounteous food supply.

In the Pinnacles region of San Benito County where the coyotes are mostly resident, the best catches of coyotes were made when sheep were concentrated in a relatively small area. Trapping became poorer when sheep ranged over greater areas in the spring. In Kern County on 1M very few coyotes were taken on the refuge when the sheep had been moved to the valley ranges. From the information at hand, the movement of sheep has a greater effect on the abundance of coyotes in a given locality than any other factor.

Trapping on certain areas did not prove worth while. The Gray Lodge Refuge in the Sacramento Valley north of Marysville Buttes at an elevation of 60 feet, is a good example. No coyotes were secured in 38 days of trapping, with 25 miles of trap line each day, and an average of 30 sets per day.

Refuge 1G in Tehama County was not satisfactory possibly because of private trapping to the west on the wintering ground.

Part of 1-O in El Dorado County in the drainage basin of Big Silver Creek and its middle fork did not produce a coyote during a month's trapping in July when coyotes should have been in that region. No signs of coyotes were in evidence. A total of 393 miles of line with 659 sets were exposed during the month.

The Mount Hamilton region is interesting because in the refuge, which includes the mountain above the 2200-foot contour, practically no bobcats or coyotes are found at any season, while around the base of the mountain below the refuge they are not uncommon.

It is impossible for coyotes and bobcats to be numerous beyond their food supply. When the population reaches the point where the food begins to decrease, then the predators must decrease. The coyote is dependent to a large extent on rabbits and squirrels, and where coyotes are plentiful, as in San Benito County, squirrels and rabbits are also numerous. Although quail are particularly abundant (more than 300 were seen per day) in all parts of that area trapped, only one coyote out of 175 had quail remains in its stomach. Only two coyotes out of 563 trapped, in this study, had quail remains.

In this same region in San Benito County wood rats, which are the bobcat's mainstay, are fairly plentiful and we found bobcats were

also relatively numerous. In only five bobcat stomachs were we able to find quail remains.

In refuge 2A in Lake, Mendocino and Glenn counties, where the squirrel and rabbit population is low, coyotes were not numerous. However, the bobcat population was fairly high as was also the wood rat. In all the refuges trapped only two coyote stomachs contained fawn hair and these were both from San Benito County.

HISTORY OF THE YOSEMITE ELK HERD

By JAMES MOFFITT

All photographs courtesy of National Park Service

Some of the hundreds of thousands, more properly millions, of visitors to Yosemite National Park during the past twelve seasons may, upon returning next year or later, wonder what has become of the elk herd that ranged the meadow near Yosemite Lodge. To answer this question and also to put on record the planting, success and final departure of the herd from the valley is the purpose of this paper.

This elk was first recognized as being different from other North American elk in November, 1904, by Dr. C. Hart Merriam, then Chief of the U. S. Bureau of Biological Survey, and was described by him as a distinct species in February, 1905 (*Proc. Biol. Soc. Wash.*, vol. 18, 1905, pp. 23-26). Merriam called this animal *Cervus nannodes*, or the dwarf elk. It is also variously known as the California valley elk, valley elk, tule elk and dwarf wapiti.

The first attempt to transplant valley elk was made in November, 1904, by the Biological Survey under Dr. Merriam's personal direction. In this year, a single calf was introduced into Sequoia National Park, but the following season 20 elk were successfully planted there (Merriam, C. H., *The Scientific Monthly*, Nov. 1921, pp. 465-475).

In 1914, a group of California naturalists and sportsmen concerned themselves with the status of the California valley elk. At that time but a single herd estimated at 400 individuals existed on the Button-willow Ranch of Miller and Lux in Kern County. The danger of "keeping all your eggs in one basket," so to speak, was apparent, for if disease or some other factor exterminated this herd the species would become extinct. The late Dr. Barton Warren Evermann, then Director of the California Academy of Sciences, and M. Hall McAllister, present Chairman of this institution's Committee for the Conservation of Wild Animal Life, were the fathers of a movement to rectify this precarious condition. Briefly, a plan was adopted to catch and distribute to several favorable localities scattered over the State, a portion of the Kern County elk herd. This was accomplished in the years 1914 and 1915 with the cooperation of Miller and Lux, Inc., and the California Academy of Sciences. In 1914 the academy distributed 54 animals to seven areas as recorded in Dr. Evermann's interesting article on the subject in CALIFORNIA FISH AND GAME (vol. 1, pp. 85-96). The following year 92 elk were introduced into 14 additional localities (Evermann, CALIFORNIA FISH AND GAME, vol. 2, pp. 70-77). Twelve of these animals were sent to Del Paso Park at Sacramento.

These plantings constituted fulfillment of the academy's original program. M. Hall McAllister, co-leader in the venture with Dr. Evermann, however, always cherished the desire that a planting might also be made in Yosemite Valley. The first concrete move in this direction seems to have occurred on December 26, 1918, when McAllister and the

late Stephen T. Mather, then Director of the National Park Service, lunched together in San Francisco, and McAllister broached the subject. Correspondence shows that McAllister, with characteristic energy, followed up this opening and in the next spring definite steps were taken in this regard.

At that time the Park Service's policy was not against exhibiting caged or exotic species of animals in the National Parks, and the only concern over the venture seems to have been the fear that the animals might not survive the severe winters of Yosemite. In order to secure information in this regard, the Park Service addressed leading authorities on the subject. One of them, Dr. Joseph Grinnell, Director of the California Museum of Vertebrate Zoology, ruled that the animals should not be introduced into the Valley for the reason that they were never native to the region, a contention that Grinnell has steadfastly upheld to the present day, and which finally became one of the main reasons for removing the elk from Yosemite. Grinnell's original objection was overruled by Dr. T. S. Palmer of the U. S. Bureau of Biological Survey, an ardent supporter of the elk introduction, with the prediction that the animals would thrive in the Valley where they would comprise an attraction to thousands of visitors, while few people would see them in their native habitat at Buttonwillow.

Official sanction of the elk introduction into Yosemite was provided by the Director of the National Park Service on March 10, 1920, when an agreement was entered into between this body and the California Academy of Sciences which stipulated that the academy would bear all expenses of materials and cost of erection of a corral for the animals and would deliver to the Park Service at El Portal not to exceed 10 live elk. In return, the Park Service agreed to assume transportation expenses for the materials and the animals from El Portal to the Valley, expenses incident to care and feed for the animals after their delivery, upkeep of the corral and such other subsequent expenses in connection with the herd as might arise.

July, 1920, saw completion of the elk paddock, an enclosure of 28 acres, fenced with heavy woven wire eight feet high and costing over \$2,000. It was now ready to receive the animals and arrangements were made by the academy to procure some elk from the herd that was planted on the Monterey Peninsula in 1914 and which had increased greatly. Efforts made by the Del Monte Properties Company in August and September, 1920, to capture elk from this herd proved failures and they were unable to deliver the animals. On account of the lateness in the season, efforts to effect the introduction were abandoned for that year in October.

The academy made new arrangements the following spring and on May 23, 1921, four animals, three cows and a six weeks old bull calf, were introduced into Yosemite Valley from the Del Paso Park herd near Sacramento. Four days later one of the cows died, presumably from injuries received while she was being roped and captured. The remaining three elk quickly adapted themselves to their new habitat.

August 20, 1921, nine additional elk were introduced into the Yosemite paddock from the Buttonwillow Ranch of Miller and Lux where they were caught by cowboys with riatas. Quite evidently, some of these animals were injured by their capture in this manner and two

of them, a bull calf and an old cow, died shortly after arrival. The remaining seven Buttonwillow elk withstood the introduction well and on September 1, 1921, the Yosemite herd numbered 10 healthy animals consisting of 4 bulls, 5 cows and 1 bull calf.

The winter of 1921-1922 was one of unusual severity in Yosemite with deeper snow on the ground than had been experienced in many years. It was necessary to erect a shelter to protect the elk from the weather and they were fed alfalfa hay. In spite of this condition, the animals appeared to weather the first half of the winter satisfactorily for on February 14, 1922, then Superintendent W. B. Lewis wrote M. Hall McAllister that the elk seemed to be pulling through, though they were not so sleek or fat as in the fall. Conditions must have been even more severe in the following months, for the next record available, as of May 2, 1922, notes that five of the animals died in the spring, leaving only 4 cows and 1 yearling bull.

This proportion of sexes was thought to be unbalanced, so on May 12, 1922, a yearling bull was introduced into the Yosemite elk herd from Del Paso Park, and the real start of the Yosemite herd should probably be counted from that date when it was composed of 4 adult cows and 2 yearling bulls. None of the cows calved in 1922, but the fact that two cows bore calves respectively on May 9 and 10, 1923, is of note as it indicates the fecundity of the yearling or 15 months old bulls in the previous fall.

The following table demonstrates the growth of the herd and its occasional losses from July, 1922, to the time of its departure from the Valley in 1933, as nearly as it has been possible to ascertain this information from available records.

<i>Date of record</i>	<i>Total animals in herd</i>	<i>Bulls</i>	<i>Cows</i>	<i>Calves</i>	<i>Loss and reason therefor</i>
July 1, 1922-----	6	2	4		
July, 1923-----	8	2	4	2	
July, 1924-----	11	4	4	3	
July, 1925-----	13	7	3	3	1, 2-yr.-old cow died in 1925.
July, 1926-----	15	8	5	2	
July, 1927-----	16	9	5	2	1 animal escaped from corral.
July, 1928-----	19	10	6	3	
July, 1929-----	22	10	9	3	
July, 1930-----	23	10	9	4	1 calf died soon after birth, and apparently 2 others died this year.
July, 1931-----	23	11	10	2	Loss of 2 elk unaccounted for in this year.
Jan., 1932-----	22	10	10	2	1 bull died of old age, Dec. 22, 1931.
Feb., 1932-----	18	6	10	2	4 bulls killed for scientific purposes, Feb. 21, 1932.
July, 1932-----	21	7	11	3	
July, 1933-----	27	7	11	6 and 3 yearlings.	

The elk were kept in the corral continually from the time of their arrival until April 29, 1927, when it was decided to open the gates and permit the animals to leave the enclosure and to roam the Valley at will. This experiment proved to be a failure because of danger of injury to Park visitors, particularly from the bulls that become quite pugnacious during the rutting season. Therefore, all the elk were returned to the corral on November 16, 1927, and were not again released. Sometime later, however, four animals broke through the fence and gained a liberty that three of them enjoyed for a month before they were returned to the corral. The fourth animal escaped permanently and sometime later was reported as having been seen by Game Warden

C. L. Brown, west of Mariposa, when it appeared to be in good condition, but has not been heard of since.

Records made available for preparing this paper fail to provide the reasons for the loss of two elk in 1930 and a similar number the following year; presumably the animals died from some natural causes. The bull that died December 22, 1931, after two weeks' illness was quite evidently past his prime. He had small 5-point antlers and his teeth were worn to the gums, some of them being badly infected and ulcerated.

From 1924 until 1932, the number of adult bulls equaled or outnumbered the old cows in the Yosemite herd. It is thought that this condition was responsible for the small number of calves that were born each year as an excess of fighting on behalf of the disproportionate number of bulls probably interfered with their breeding activities. At any rate, the proportion of sexes was deemed unsatisfactory so the Park Service, early in 1932, decided to remove some of the surplus males and on February 21, four adult bulls were killed and their remains were preserved for scientific study by several California institutions. The favorable effect of this reduction of surplus males upon the herd is indicated by the fact that six calves, two more than were born in any other season, were dropped the following spring, although it is a fact that the mating season was over before the surplus males were killed.

Early in 1928, sentiment began to develop against keeping the elk in Yosemite Valley permanently. For one thing, the tremendous increase in the number of annual visitors to the Valley since the original introduction in 1922 resulted, by 1928, in the need of every foot of available space on the valley floor for the accomodation of the public. Park officials saw that the space occupied by the elk corral would soon be required for this purpose. The unsatisfactory experiment of liberating the animals in the Valley in 1927 indicated that relief could not be found in this direction. Another reason for the change in sentiment toward the elk was that by 1928 the National Park Service's policy with reference to exhibiting caged or nonnative animals within the Parks had altered, and the Service was now definitely on record against such exhibits.

A letter from Acting Superintendent E. P. Leavitt of Yosemite National Park to M. Hall McAllister in June, 1928, outlined the Service's attitude regarding this problem, but stated that no immediate action was planned. The subject was carefully considered by the National Park Service during the next months when opinions regarding it were secured from interested persons both within and without the organization. Some of the opinions may be of interest for notwithstanding the need of the space occupied by the elk corral for the public's use, then Assistant Field Director Horace M. Albright and now Assistant Director Dr. H. C. Bryant were among the Service's men who expressed the hope that it might be possible to keep the animals in the Valley. Superintendent Thomson tenaciously contended for their removal from the Park. Dr. Joseph Grinnell was, as originally and always, opposed to keeping the elk in Yosemite because they are nonnative to its fauna. M. Hall McAllister suggested if the land occupied by the paddock was required for other purposes, it might be possible to erect a corral in Bridalveil Meadows or elsewhere where

space was available and to transfer the animals there. He also suggested the possibility of reducing the size of the herd and keeping its maximum at 12 animals, the surplus to be butchered and marketed, or turned loose. Thus the matter was, from time to time, brought up and discussed for a period of nearly three years, but no definite solution was reached.

Early in 1932, Superintendent Thomson interested Charles G. Dunwoody, Director of Conservation of the California State Chamber of Commerce, in the National Park Service's problem with the Yosemite elk herd which he hoped to solve by locating a satisfactory area in which to place the animals. Dunwoody at a subsequent meeting of the State Chamber, announced Superintendent Thomson's problem and asked if any of those in attendance could suggest a suitable place to which to transfer the herd.



Fig. 7. This type of country extends along the Owens River for at least 60 miles. The elk were released on the river about at the place marked by the cross. The Sierras are seen in the background, the White Mountains border the other side of the valley.

G. W. Dow, Lone Pine, a leader among Owens Valley sportsmen, was present at this meeting and stated that he would like to have the elk moved to Owens Valley. Dow explained that he considered this an ideal locality in which to permit the animals to roam at large a strip of seemingly ideal habitat bordering Owens River for a distance of nearly 70 miles and owned almost entirely by the City of Los Angeles. He pointed out the natural attractions of Owens Valley for elk habitat, stressing the fact that little agriculture now exists in the valley with which the animals could interfere and asserted that the sportsmen and people of the vicinity would welcome the introduction and protect the animals.

Dow and Dunwoody shortly thereafter met with other interested parties in Los Angeles to contact the Water and Power Board with

reference to the plan. This group's inquiries met with the immediate favorable reaction of the board and soon the City of Los Angeles issued formal permission to introduce elk into its Owens Valley properties. Credit is due to Messrs. Dow and Dunwoody, Roy Booth, Supervisor of the Inyo National Forest, Dean L. Sears and Dr. M. A. Williamson, both of Lone Pine, and the Water and Power Board for bringing the matter to such a speedy and successful conclusion.

In the meantime, Dunwoody and Dow corresponded in this regard with C. G. Thomson, Superintendent of Yosemite National Park, and kept him informed of their progress. Supt. Thomson seemed to favor the plan from the start. On May 10, 1932, Dunwoody advised the Superintendent that details were completed with the City of Los Angeles and that the permit had been granted. A few days later, Dow advised Supt. Thomson that he was already to send trucks in which to move the animals. This prompt action was a bit premature, for the National Park Service had not yet decided to move the elk and would not agree to do so until it was satisfied beyond any question that the herd would succeed in its new location.

The National Park Service soon delegated George M. Wright, Chief of its Wild Life Division, to conduct a thorough study into the details of the proposed transfer both from the viewpoint of its desirability and necessity, and of the suitability of Owens Valley for the animals' success. Wright, on account of other work, was unable to undertake this investigation until the following spring. On June 1, 1933, he rendered a most comprehensive report on the subject to the Director of the National Park Service. It seems advisable here, even at the expense of some duplication in this paper, to put a goodly portion of this report on record, for it indicates how thoroughly the Park Service went into the matter before reaching a decision.

In regard to the necessity and desirability of removing the elk from the Park, Wright outlined the manner in which conditions as they obtained in 1922, when the elk were placed in Yosemite, had changed, as follows:

1. Now contrary to policy to harbor exotics in a National Park.
2. Against National Park policy to exhibit animals in confinement.
3. Inconsistent with National Park's educational program, which is to stimulate visitors to study nature in place, to have elk enclosed in a paddock within sight of its Educational Museum, a living contradiction to this principle.
4. Space used by elk pasture required for caring for great crowds of Park visitors.
5. Maintenance of elk herd costs Educational Department of Yosemite \$400 per year for feed for animals.
6. Need for preserving species from extinction that threatened in 1922, now removed with establishment [in 1932] of 1000 acre State Park in San Joaquin Valley with 140 Tule Elk on it.

Wright's report then outlined the requirements that should be met before acting on the proposal to transfer the animals to Owens Valley, as follows:

1. Obtain approval of California Academy of Sciences.
2. Obtain approval of scientific group at the University of California.
3. Obtain approval of the California Division of Fish and Game.
4. Local inhabitants should be favorably disposed to the introduction.

(This requirement already met by assurance of G. W. Dow and other residents of Owens Valley.)

5. That there should be no danger of conflict with economic interests. (This requirement met, no danger of conflict with agriculture for the few remaining farms in Owens Valley are being rapidly acquired by the City of Los Angeles and when its program is completed, there will no longer be any farms there. Presence of elk should be conducive to the prosperity of inhabitants of Owens Valley because of their interest to the tourist trade



Fig. 8. Messrs. Walker, Dow and Merrill demonstrate the height of undergrowth which covers large areas along the Owens River. This should make an ideal home for the elk.

which is a source of considerable income to residents. Stock grazing is no longer heavy in Owens Valley and is now being reduced by the policy of the Water Board. Therefore, feed is abundant and the elk should prosper.)

6. Elk should range on publicly owned lands. (This requirement already met as the City of Los Angeles owns 90 per cent of the land in Owens Valley.)

7. Obtain a means to finance the cost of moving the elk. (G. W. Dow already offered to be responsible for this.)

8. Essential that plan of liberation be conducive to the independent existence of the herd. (Owens Valley seems ideal in this respect for an abundant stretch of moist river bottom land, 60 miles or more in length, with an abundance of willows, tules, rushes, grasses, mud lakes and water, such as is considered excellent Tule Elk habitat, exists there. Temperature extremes in Owens Valley are comparable with those of the Upper San Joaquin Valley where Tule Elk once abounded. Although the elevation is greater than in the San Joaquin Valley, snows that remain on the ground occur only with the greatest rarity in Owens Valley. Nature has fenced the valley to preclude the animals' escape from it, for if the elk attempt to leave the river marshes, high mountains or hostile deserts hem them in on all sides. These factors seem to meet this requirement.)

Wright closed his report with the following recommendations regarding the elk transfer. First, that it is his opinion that the animals would prosper in Owens Valley. Second, that the transfer be



Fig. 9. Bull elk after dehorning. After their horns were removed, they quieted down, showing little interest in each other.

made in late fall, after the rutting season when the bull's horns could be sawed off to prevent their injuring themselves in transit, when the calves would be large and strong enough to stand the trip and when the cows would already be impregnated to insure securing a calf crop the following spring.

Director of the National Park Service H. M. Albright on June 20, 1933, approved Wright's recommendations and authorized the transfer provided that each requirement was met before making the shipment. Accordingly, Supt. Thomson addressed the agencies whose approval was required, requesting that same be granted.

Dr. C. E. Grunsky, President and Acting Director of the California Academy of Sciences, provided Supt. Thomson with that institution's approval of the transfer on September 15, 1933, but expressed some reluctance over it for the reason of M. Hall McAllister's opinion in

its regard. It is only fair here, in deference to McAllister's unfailing interest in the Yosemite elk herd, to put on record his views in this regard, which everyone, including McAllister himself, hopes will prove to be unfounded. McAllister believes that the move is to be regretted because the elk had a good home in Yosemite where their increase was normal. He thinks that fewer people will see and enjoy them in Owens Valley than in Yosemite and fears the danger of their raiding farms there, citing the examples of the Monterey and Eden Valley (Mendocino County) introductions, where ranchers are said to have protected themselves against elk depredations to their crops by employing rather drastic means of control.

Dr. Grinnell had already, in March, provided Wright with his views regarding the transfer, writing that he considers "Owens Valley appoints the best of their own home range." He is enthusiastic over the prospects in Owens Valley for the species, and is glad that the herd has been removed from Yosemite.

Executive Officer J. L. Farley expressed to Supt. Thomson the California Fish and Game Commission's attitude on the subject on September 8. This was that the Commission approved the transfer but can not undertake to purchase feed, if necessity for same arises, for the elk in their new home. Further, that in so far as it is consistent with its other duties, the Commission will endeavor to protect the herd in Owens Valley.

All the conditions having been satisfactorily met, Supt. Thomson on September 30, 1933, so informed the Director of the National Park Service and advised him that the transfer date had been set for October 10.

Meanwhile rather careful and elaborate preliminary work was being done in Yosemite by the Park Service. Specifications for carrying crates were secured from Yellowstone National Park, and the requisite number were constructed in Owens Valley at G. W. Dow's expense. Preshipment handling of the animals themselves can best be described by quoting from Chief Ranger F. S. Townsley's report in this regard (see Figs. 9 and 10) :

For several weeks before the transfer, very definite plans were made to handle the elk with as little difficulty as possible so as not to get them excited. The old deer trap at the upper end of the pasture was rebuilt and a dehorning shoot was made so that it could be used to force the elk into the shipping crates.

The dehorning was done over a period of several days, by trapping only one or two bulls at a time; the rest of the herd did not realize that anything unusual was taking place.

A few days before they were to be crated, all water was shut off except inside the trap, resulting in very little excitement when some of them had to be driven through the trap door.

At the same time, Dow was active on the "receiving end" in Owens Valley. There, bordering Owens River, near Aberdeen, about 14 miles from Independence (see Figs. 7 and 14), he constructed a paddock in which the herd was to be held for a week or ten days after arrival and fed hay until they became acclimated. Materials for the construction of this corral were supplied gratis by the Department of Water and Power of the City of Los Angeles and by some enthusiastic Big Pine and Lone Pine business men. Several employees of



Fig. 10. Small paddock used in connection with trap, trapdoor up ready for use. Two inside doors made it possible to force one elk at a time into dehorning shoot and shipping crate.



Fig. 11. Forcing elk to front of crate so door could be bolted on. Mr. Dow at front of crate adding some reinforcement with wire. Chief Ranger Townsley at the right, holding prod.

the City Department of Water and Power assisted in the erection of the fence, on their own time. He also arranged to supply a large truck for hauling the crates to Yosemite and the elk back to Owens Valley and arranged to come himself to Yosemite for the loading and then accompany the animals home. Dow personally expended several hundred dollars in connection with this venture in which he was assisted by a \$100 appropriation from the County of Inyo. The Division of Fish and Game donated the use of one of its large fish planting trucks for hauling the elk, and the services of Fish Planting Assistant E. L. Walker and Game Warden C. J. Walters. The Government supplied a third truck from the Civilian Conservation Corps and a driver for same, Lee Rust.

This equipment was assembled in Yosemite the evening of October 9 and the work of loading the elk was commenced at 8 a.m. the following morning under the supervision of Chief Ranger Townsley (see Fig. 11). Six of the bulls were loaded into individual crates which were placed on the Division's truck and left the valley at 3.30 p.m. (see Fig. 12). By 6.30 p.m., 16 more animals were individually crated and loaded on the large semitrailer type of truck furnished by Dow. This truck left Yosemite an hour later, escorted by Dow in his private sedan. The remaining elk, five calves, were loaded into two crates on the C. C. C. Chevrolet truck which left the valley at 9 p.m. Ranger W. K. Merrill and Assistant Park Naturalist A. E. Borell accompanied Rust in this truck.

The trip from Yosemite to Owens Valley is well described in Ranger Merrill's report from which the following is quoted:

Ranger Naturalist Borell, Lee Rust and I left at 9 p.m. in a truck with five young elk.

We arrived at Fresno at 1.15 a.m., inspected the elk, gassed the truck and left at 1.30 a.m. I relieved Rust from driving from Fresno to Bakersfield.

We overhauled the second load of elk about twenty-five miles this side of Bakersfield. We arrived at Bakersfield at 5 a.m. Borell relieved Mr. Dow at the wheel and Rust relieved me.

Arrived at Mojave at 9 a.m., had breakfast, inspected the elk and tried to water them, but they would not drink. We left at 9.35 a.m. I relieved Rust to Olancha.

We arrived at Lone Pine at 1.30 p.m., unloaded some of our things, got some more help to unload the elk and left Lone Pine for the elk refuge, which is some forty miles beyond Lone Pine, at 2 p.m. We arrived at the refuge, which is some three miles off from the main highway, at 3.15 p.m.

Assistant Park Naturalist Borell's report of the transfer contains some information relative to the animal's new home in Owens Valley that is of interest and is quoted, in part, as follows:

The 27 elk (7 bulls, 3 yearlings, 11 cows, and 6 calves) were crated, under supervision of Chief Ranger Townsley and hauled from Yosemite Valley to Owens Valley under escort of Merrill and Borell. Each adult animal and two of the largest calves were in separate crates which were furnished by Mr. Dow. Some of the bulls fought viciously during the crating and as a result were rather badly bruised and skinned up by the time we got them loaded. Once on the road the animals were quiet and I believe received no further injury. We tried to water them at Mojave, but they refused to drink. It was cloudy and cool, there was no car trouble or other delay en route. All except one old bull was delivered in good condition.

The paddock into which we released them is on the Owens River near Aberdeen, which is 14½ miles northeast of Independence, Inyo County. The new home of the elk seems to be ideal, plenty of water, abundance of willow,



Fig. 12. The first load of elk left on Fish and Game Commission truck at 3.30 p.m., October 10. The next truck (seen at left rear) furnished by Mr. Dow (standing third from left) started at 7.30 p.m. Government truck with five calves left at 9 p.m.



Fig. 13. The next morning after delivery the elk seemed to be full of life.

tule, undergrowth and grass. Much of the undergrowth is from three to six feet high (see Fig. 8). Most of the area belongs to the City of Los Angeles and is used only for watershed and cattle grazing. There are a few private ranches left in the valley, and if the elk take to these ranches, there may be difficulties. However, the ranch nearest to the place of liberation was 10 miles south.

Mr. Dow, the Fish and Game officers, and county sheriff seemed to be extremely interested in the welfare of the elk and will do everything they can in the way of care and protection. The animals will be kept in the paddock about a week, until they recover from the trip.

The preceding excerpts from reports of Park Service employees indicate the successful manner in which the elk transfer was executed. Too much praise can not be given these men for their care and foresight in this regard. Dr. Grinnell, writing Superintendent Thomson on November 8, 1933, said: "You can not overestimate my personal satisfaction that the transfer of the elk out of Yosemite Valley was so successfully accomplished. It is evident that a lot of administrative thought and skill was necessary to bring the whole undertaking to conclusion. * * *" It is believed that the careful preshipment handling and loading methods used were largely responsible for the ultimate success of the transfer, for, in the case of the earlier elk plantings, considerable loss seems to have resulted from rough handling of the animals prior to shipping (see Evermann, CALIFORNIA FISH AND GAME, vol. 2, 1916, p. 77).

It may well be, too, that the modern methods of transportation used in the present transfer (see Fig. 12) and resulting in the animals being confined in their crates for a minimum of time, also influenced the final success of the venture. For transportation by modern automobile trucks presents a strange contrast to the horse-drawn wagons used in the earlier plantings (see Fig. 24, CALIFORNIA FISH AND GAME, vol. 1, 1915, p. 92).

The elk apparently adapted themselves quickly to their new surroundings in Owens Valley. All, with the exception of an old bull that was injured prior to shipping, seemed to thrive in the holding pen in which they were kept for nine days. The following account of their liberation from this pen on October 20 is quoted from a letter by G. W. Dow to Supt. Thomson.

We liberated the elk at 9.30 this morning with 100 per cent of the herd in fine condition or in as fine condition as they were when loaded at Yosemite. The old bull that had been hurt previous to the transfer seems to be getting along fairly well and while we have been doctoring him some every day since his arrival here we decided that he would be about as well off turned out of the corral.

We opened the gate this morning and after some time we persuaded them to come out and after they were out in the open they realized there was no fence and they galloped off through the willows and disappeared, with the old bull following along behind calling them. We tried to follow them a short distance but decided they had left and had gone to see if they could find the end of the pasture. After circling around with our cars we made a trip down the river and found that they had not passed so presumed they had not gone very far so we all returned home. About an hour later one of my former employees went down to the corral thinking he would have a chance to see the elk and found that the herd had all returned to the corral.

While the elk were in the corral we fed them about a ton of hay and I believe they were beginning to put on some flesh.

Mr. Carl Walters and Mr. Gene Walker of the Fish and Game Department have taken a very keen interest and have made a trip to the corral every day since the elk arrived.

A later report upon the successful adaptation of the herd to its new habitat was provided by Assistant Executive Officer A. E. Burghduff on November 10, when he wrote as follows: "I saw this band of elk this week and the entire shipment is looking fine except for one crippled bull elk that died because of its injury." Evidently, the old bull that was injured prior to shipping and probably should not have been transferred, died of his wounds. The remaining elk, consisting of the following animals, then comprise the nucleus of the Owens Valley herd: 6 bulls, 11 cows, 3 yearlings and 6 calves; a total of 26 animals made up of what is thought to be an excellent proportion of sexes.



Fig. 14. Tule elk in temporary holding corral on Owens River near Aberdeen, Cal. October 12, 1933.

Beside the individuals and agencies previously mentioned in this paper as being concerned directly or indirectly with the elk transfer, especial mention should be made of G. W. Dow's unfailing interest and work in its consummation. It would be impossible to give Dow too much praise and credit for his trouble and labor in this regard.

The author prepared this paper at the request of Executive Officer Farley and with Superintendent of Yosemite National Park Thomson's approval. Supt. Thomson kindly furnished correspondence that was helpful in preparing the article and the photographs which are here used for illustrations. A visit to Yosemite Park was necessary to secure further data and it is a pleasure for the writer to acknowledge the help and cooperation afforded him at that time by Chief Ranger Townsley, Park Naturalist C. A. Harwell and Assistant Park Naturalists Beatty and Borell. Harwell informed us that he had in the course of preparation a paper on the habits of the Yosemite elk herd. On account of the

accessibility and ease of study of the animals when they were confined in the Valley, unusual opportunity afforded for observing their habits and we will look forward to the appearance of Harwell's paper in this regard.

In addition to those mentioned above, the writer is indebted to Assistant Executive Officer Burghduff, Joseph Dixon, Field Naturalist of the Wild Life Division, National Park Service, and to M. Hall McAllister for information and assistance in the preparation of this paper.—*December 20, 1933.*

MULE DEER STUDY PROGRAM

By JAMES MOFFITT

The Division of Fish and Game has received numerous reports in the past two or three years from its game wardens, sportsmen, game conservationists and U. S. Forest Service employees purporting a decline in the numbers of mule deer inhabiting the northeastern portion of the State. Deer kill statistics indicate a reduced kill in this area in the past two seasons, which, as discussed beyond, may indicate deer depletion in this section. The Division has investigated the matter and is of the opinion that some reduction, although not an alarming one, has occurred among these deer in recent years. It now desires to ascertain the reasons for the depletion in order that remedial measures may be undertaken.

Before proceeding with an explanation of the mule deer study program, by which means it is intended to procure the information needed, it seems desirable to indicate in more detail than has heretofore been done the range of mule deer in this section, to review the status of these deer in the past and the kill statistics for the area, to recount the increasingly restrictive game laws enacted in recent years and to speculate upon some of the probable reasons for the recent depletion.

The species concerned is the Rocky Mountain mule deer, *Odocoileus hemionus hemionus*, which California hunters often term the "Modoc" mule deer in distinction from the smaller California mule deer (*O.h. californicus*) of southern California. This is the common deer of Modoc County and it is also plentiful in most parts of Lassen County, the eastern half of Siskiyou County and in extreme eastern Plumas, Sierra and Nevada counties (see Fig. 15). South of Placer County, where this deer is of rare occurrence, its status is not well known but a few individuals undoubtedly enter California in summer along the eastern border south to Mono County, where the present species is thought to meet the range of the newly described Inyo mule deer (*O.h. inyoensis*), (see CALIFORNIA FISH AND GAME, vol. 19, 1933, p. 274). Therefore, the vast majority of the Rocky Mountain mule deer's range in the State is included in the area under consideration, which, for convenience, will be termed the "Modoc" region.

The accompanying map (Fig. 15) indicates as nearly as the writer has been able to ascertain, the average summer range of the Rocky Mountain mule deer in California. Some few individuals may, in summer, stray west of the north and south line drawn through Shasta Valley, but the bulk of the mule deer in this section doubtless stop their westward spring migration at this valley's eastern edge. Similarly, further south, occasional mule deer may be noted west of the boundary line indicated; but it is believed that in general this line marks the western range of this deer. Columbian black-tailed deer (*Odocoileus columbianus columbianus*) frequently occur east of this line, in fact they do so commonly and regularly at many points. This is especially

true in summer, when the black-tailed deer that generally winter to the westward invade the eastern parts of Siskiyou, Shasta, Plumas, Sierra, Nevada and Placer counties and western Lassen County. Some black-tailed deer probably winter with the mule deer east of the boundary line, as in eastern Siskiyou County (Red Rock Valley) and in eastern Plumas County (east of Quincy between Keddie and Beckwith peaks, *fide* L. E. Mercer), however the great majority of black-tails winter to the westward. In preparing this map, no attempt has been made to show the eastern range limit of black-tailed deer or the winter range of mule deer.

Mule deer winter at many points throughout the area that they occupy in summer. In fact they winter almost wherever snow depths will permit them to do so throughout their summer range. When they migrate, they generally, but by no means always, do so to the eastward in fall, but at a considerably later date than do the black-tails move westward. There is never a winter mule deer migration west of the summer line shown on the map and it is of the greatest rarity that an individual of this species is said to accompany the black-tails to the westward, however, there are one or two purported records of this having happened in Tehama County. Mule deer winter west to Red Rock Valley, Siskiyou County, in the vicinity of Game Refuge 1-B and in the rough lavas south of it. In heavy winters, when deep snows invade the 1-B country, these deer are said to work westward into Red Rock Valley which is an area of less snowfall (*F. R. Starr*). They also winter in the Crowder Flat country, along both slopes of the Warner Mountains, and on Big Mountain, near Adin, Modoc County (*A. A. Jordan*). A considerable number winter on Bieber Mountain in northwestern Lassen County and in extreme southwestern Modoc County (*Paul Kehrler*). The country between Pittville and Westwood has too much snowfall to permit deer to winter there and the mule deer of this area work eastward in late fall to winter east of the Madeline Plains and in Game Refuge 1-Q, to or across the Nevada line. The animals that summer in eastern Plumas County southwest of Honey Lake along the main divide of the Sierra Nevada Mountains winter on the east slopes of Long Valley and east into western Nevada, south of this point all Rocky Mountain mule deer summering in California apparently winter in Nevada. It should also be mentioned that many, if not most of the mule deer summering in that section of extreme south central Oregon, bounded by the towns of Malin, Bly and Lakeview, apparently migrate southwesterly in fall to winter in the vicinity of Game Refuge 1-B in Modoc County.

According to the reports of some early residents of the Modoc region (L. N. Lorenzen, Mt. Shasta, Thomas Ivory, Canby, and others) in the early days, fifty years or so ago, mule deer were not at all plentiful in the area. Lorenzen recently told the writer that old time cattle riders have informed him that one could ride for a day without seeing a deer in regions where similar excursions today would reveal many of these animals. Deer seem to have increased steadily in the Modoc region from early times until about 1928 when most local inhabitants agree that the peak population for modern times was attained. The following year, and 1930, was apparently the time that the present depletion commenced. The winter of 1932-1933 may,

and we hope did, mark the low point in this decline, for a number of local informants have recently expressed to the writer the view that there were more deer in the area in 1933 than in the previous year. Although many people have been interviewed on the subject, it is

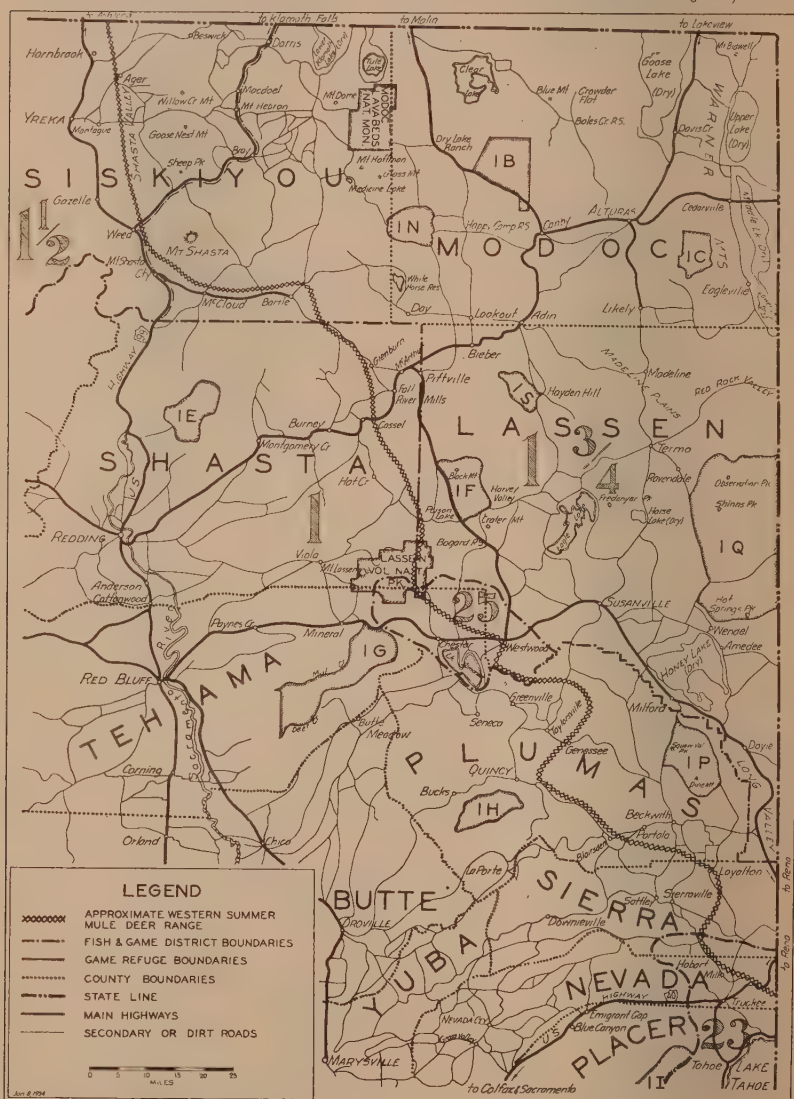


FIG. 15. Summer range of the Rocky Mountain mule deer in northeastern California.

difficult to ascertain the extent of the recent depletion, however, the consensus of such opinion seems to indicate a reduction of about 15 per cent in the herd in the fall of 1932 over a similar time in 1928.

Prior to about 1920, the number of "outside" hunters visiting the Modoc region each season was small and the majority of deer killed there were taken by local residents. From that time until about 1930, the number of sportsmen from other sections of the State who made hunting trips into the area grew by leaps and bounds so that by the end of this period a veritable army of outside hunters made annual pilgrimages after these large animals. This condition naturally resulted in a correspondingly higher annual legal kill which kept pace with the increase in numbers of hunters until 1931, when reports of less comparative success began to emanate from the sportsmen. In the same period, restrictive legislation which will be discussed later, kept up with the increase in hunters and was apparently responsible for preserving the numbers of deer until 1928 or thereabouts. The Division had no means of recording the annual kill or total number of deer hunters prior to 1927 when the deer tag license law was enacted. The statistics provided below for the deer kill in Modoc and Lassen counties for the years 1927 to 1933, inclusive, will serve well to indicate the relative mule deer kill for the entire area for this period and reports from these counties only are provided for the reason that practically all the deer killed in them are mule deer whereas there is no means of distinguishing between mule and black-tailed deer, in our tag system, both of which are taken in the other counties in this area. We have no means of ascertaining the number of hunters who annually go after mule deer, but because of their known rapid recent increase in this area, we are certain that the increase of sportsmen afield in the Modoc region has been proportionately far in excess of the total increase for the State, at least through the 1931 season. The Division hopes, before the 1934 deer season opens, to evolve a means of checking hunters in and out of the mule deer area which will in future provide this much needed information.

Year	Lassen Co.	Deer killed		Total in State	Deer tags, total sold in State
		Modoc Co.	Total both counties		
1927	296	510	806	19,507	110,760
1928	393	729	1,122	21,515	105,638
1929	511	835	1,346	21,222	115,472
1930	585	1,129	1,714	24,132	123,999
1931	607	1,486	2,093	25,805	129,005
1932	508	916	1,424	18,380	96,702
1933	551	954	1,505	17,689	94,500*

* Approximate, exact 1933 total not yet available.

It should be noted in the above table that the total State deer kill in all years save 1928 bears a rather consistent ratio to the total number of deer tags sold or number of hunters in the field. At the same time, the kill in Lassen and Modoc counties increased out of all proportion to the State kill. This is a result of more hunters visiting the area, at least through the 1931 season. The decrease in the number of deer killed in these counties in 1931 and 1932 is out of proportion to the decline in deer tag sales for the same period and is probably, in part at least, a result of deer depletion. The increase in the 1933 Modoc deer kill is gratifying for, in spite of unsatisfactory (dry) hunting conditions that obtained in the region last season, more deer were taken there than in the previous year, notwithstanding a falling off in the total State kill and a decrease in number of hunters.

The fact that the numbers of Modoc mule deer held up well in the face of greatly increased hunting effort from 1920 to 1928 may probably be explained by the additional restrictions that were placed upon the hunters in that period. From 1911 to 1925, Modoc and Lassen counties were included in Fish and Game District 1 which still embraces most of the Sierra Nevada country and prior to 1919 also included Del Norte, Humboldt and Siskiyou counties. In 1919, District 1½ was formed, composed of the last-named counties. During this period the following open season on deer obtained in District 1: 1911 to 1914, August 15 to October 31; 1915 to 1920, August 15 to October 14; 1921 to 1924, September 1 to October 15. The bag limit was two buck deer per season throughout the period, but after 1915 it was illegal to kill spike bucks.

District 1¾ was formed in 1925 when it consisted of Modoc and Lassen counties. Here a 30-day open season was declared, September 15 to October 15 in contrast to the six-weeks' season that persisted in District 1 until 1927. Forked-horn deer were also protected in District 1¾, but the limit was two bucks with more than two points on a side per season. The next Legislature (1927) reduced the limit to one such buck per season in Modoc and Lassen counties and changed the open season to September 16 to October 15, which season was also adopted for District 1.

The boundaries of District 1¾ were enlarged by the 1929 Legislature to include in this district that portion of Siskiyou County lying east of the easterly bank of the Klamath River between the Oregon line and the Siskiyou line of the Southern Pacific Railway and south along this railway to the south line of Siskiyou County. This, from a biological standpoint, was an excellent boundary line, for it would be difficult to locate an artificial one more nearly paralleling the western boundary of the mule deer's range. It is a pity, therefore, that the 1931 Legislature changed this boundary to that portion of Siskiyou County lying east of the Pacific Highway (U. S. 99) between the county's southern line and the town of Weed and east of the Weed-Klamath Falls Highway between Weed and the northern line of Siskiyou County (see Fig. 15). The latter is the present boundary of District 1¾ and no changes have been made in season or bag limit since 1927. It is unfortunate that the above mentioned boundary change was made for a six-weeks' season (September 1 to October 15) and a two-buck bag limit, with no forked-horn protection, now exists in the mule deer range west of the Weed-Klamath Falls Highway. This matter should be corrected by our next Legislature and it is suggested that the Pacific Highway would provide an excellent western boundary to District 1¾ from the southern Siskiyou County line north to the Oregon line. Other westward enlargements to District 1¾ further south, especially in eastern Plumas, Sierra and Nevada counties are apparent from the accompanying map and we hope will be made in 1935. The Division endeavored to have such legislation enacted in the 1933 session, but was unable to accomplish this.

Senator Harold J. Powers, Eagleville, introduced a bill into the 1933 Legislature to shorten the open season in District 1¾ to the period October 1 to 15. This measure was supported by many sportsmen in Modoc County but most of the local hunters in Lassen

County opposed it. The writer made a trip to the mule deer area in March, 1933, to secure the views of our game wardens and others in this regard. The result of these interviews was the conclusion that the measure was not a conservation one by reason of the fact that so short a season would congest the hunters unduly. This congestion of hunters which occurs yearly in the opening days of the hunting season, is the hardest thing that the bucks have to face, for men are everywhere and once a mule buck is "jumped" he usually runs quite a distance before stopping. With a field full of hunters, if the man who jumps the buck does not kill him, there is much more likelihood that he will be shot by some other hunter before he stops running, than if there are not so many sportsmen afield. It seems desirable for this reason, to spread the season over as long a period of time as is reasonable. The Division adopted this policy and contended that the Modoc deer population was not in so precarious a position as to justify enacting this measure, which might not work out to the deer's advantage. This, and the Division's dislike to impose further restrictions on the hunters in the Modoc area until constructive measures to build up its deer population are adopted and tried out, was explained to Senator Powers who did not push his bill thereafter and it "died in committee."

The 1933 Legislature conferred upon the Director of the Department of Natural Resources, with the Governor's consent, the power to close to hunting upon recommendation of the Fish and Game Commission, any area where added protection is needed for game for such a time as the Director may designate, or until new legislation thereon may become effective. This means that the Division could probably close all, or part of the Modoc area if justification to do so developed, so with a close watch being kept upon these deer, sportsmen need not fear that undue depletion will be permitted to occur. The thought has been suggested that portions of the Modoc area might now be closed to hunting. Not only does the Division consider that no necessity now exists to do so, but it believes that such a course would only hasten to create poor conditions in the areas left open by crowding more hunters into them. It is possible that study may develop that hunters camping near water in dry sections where springs are far apart is detrimental to the deer of the vicinity. In such cases it would seem to be in order to either close the area to hunting or to prevent camping at the springs.

Factors other than increased hunting effort are doubtless at least in part responsible for the recent deer depletion in the Modoc region. Foremost among these is a disease commonly termed calf diphtheria and caused by an organism known as *Bacillus necrophorus* an outbreak of which occurred in the Medicine Lake country, especially in the vicinity of Mud Lake, in 1923 and 1924.* A more recent and widespread epidemic of this infection occurred in the same vicinity and also at White Horse and in other localities in 1931. The Division's pathologist investigated many cases of this disease from these areas in that year and definitely diagnosed the disease. This outbreak continued to a lesser extent the following year and very few reports of deer death from its cause were obtained in 1933 in spite

* See CALIFORNIA FISH AND GAME, vol. 10, 1924, p. 191; vol. 11, 1925, pp. 27-28.

of careful watch for it. Game wardens treated water holes in diseased areas with bluestone in 1933, which sterilization may have been helpful in controlling and stamping out this disease. It has been impossible to ascertain the total number of deer that succumbed to the recent epidemic, but same was considerable and conservative estimates run into the hundreds.

Illegal hunting, particularly winter killing of deer, is another factor that undoubtedly has had its effect upon the Modoc deer population. In spite of the best efforts of our game wardens, this drain on the deer herd is known to be considerable and has doubtless increased in recent years due to economic stress and unemployment. Winter deer killing in remote sections of a country that is difficult to traverse at this season on account of deep snows is one of the most difficult types of violation to apprehend. Further, the all too-liberal policy of many of our courts toward convicted violators in late years, on the plea of economic stress, has tended to ease the penalty for such violations, which fact works for more abuse of our game laws.

Another possible factor to reckon with in regard to the status of the Modoc deer herd is that of increasingly intensive sheep grazing in the area. Formerly, much of the Modoc region was utilized for horse and cattle grazing. These animals are mainly grass eaters and they do not compete with deer for food to the extent that sheep, which also browse, do. Sheep grazing has increased enormously in the Modoc region in the past twenty years and the effect of overgrazing by these animals is apparent in many localities. This fact may have had an effect on the deer herd by reducing its available food supply.

Other factors which may work in favor of or against the welfare of Modoc mule deer are enumerated beyond in the outline of the study.

The Division decided to secure more information on Modoc mule deer preparatory to effecting game management measures in the region, in the spring of 1933. It also decided to increase the value of its game refuges in that section at the same time. The original plan to locate trappers on four of the mule deer refuges in 1933 and on additional ones in 1934 was by necessity delayed and modified in the summer on account of reduction in personnel and in income. Nevertheless, it was later found possible to proceed with a modification of this program and three skilled predatory animal trappers and field observers were located on Game Refuges 1-B, 1-F and 1-Q in the fall of 1933. In addition to removing predatory animals, especially coyotes, from these areas, these men will do everything possible for the welfare of deer and other game and will also cooperate in this study program.

The Division's Bureau of Education and Research has adopted for its chief field investigational work for 1934 (and probably succeeding years also) the administration of the present study program. The purpose of this work is to ascertain the favorable and unfavorable factors to the Modoc mule deer, means by which same can be altered for the deer herds' benefit, and to compile information that will later provide the basis of a game management program for these animals. The latter means improving habitat and other conditions so that a larger annual crop is secured and "harvesting" this crop in such a manner that the entire herd may maintain its numbers or increase. It is quite evident that our present knowledge is insufficient to permit

us to now adopt such a constructive program, so the present study has been instituted to secure the required information in as practical and speedy a manner as is thought possible.

The natural course to pursue to procure this information would be to put two or three trained biologists into the field to work out the problem. On account of reduction in income and lack of funds for this purpose, it is impossible for the Division to do so at the present time. Because we believe that it is imperative to secure information on the subject at once, we have, therefore, decided to do the best we can with our available man power and observations will be made by game wardens and predatory animal trappers under the supervision of two of the Division's biologists.

Three game wardens, A. A. Jordan, P. Kehrer and F. R. Starr, men with proven ability to make accurate field observations, will conduct prescribed courses of study in as many areas in Siskiyou and Modoc counties. Each of these men will have a predetermined work area on which he will be required to do several days' work each month. The exact location of these areas will not be divulged for the obvious reason that such a course would probably interfere with the study, which it is desired be made under absolutely natural conditions.

Three State predatory animal trappers, A. L. Brown, J. L. McDonald and O. R. Shaw, who were selected on account of their ability to make and record wild life observations, will, in addition to their trapping and patrol duties on State game refuges, conduct similar programs of study on portions of their respective areas. One of these men is located in Modoc County and two of them are stationed on Lassen County game refuges. Thus one man will conduct the study in Siskiyou County, three in Modoc and two in Lassen counties. The writer will direct the work of the game wardens and D. D. McLean, Bird and Animal Economist, Bureau of Game Refuges, will supervise the activities of the trappers. Junior Range Examiner F. W. Johnson, U. S. Forest Service, will cooperate with all the workers and his excellent knowledge of range plants will greatly assist them in the study of food plants and range conditions.

The course of study outlined below was prepared at a meeting of Joseph Dixon, Field Naturalist, Office of National Parks, Buildings and Reservations, Dr. E. Raymond Hall, Curator of Mammals and I. McT. Cowan, University of California Museum of Vertebrate Zoology, J. S. Hunter, Chief, and D. D. McLean, Bird and Animal Economist, Bureau of Game Refuges of this Division, and the writer. The meeting was held in Berkeley, November 22, 1933.

The writer presented the program adopted at this meeting to members of the the U. S. Forest Service and State game wardens at Mt. Shasta November 27. Among those present were: Supervisor T. J. Jones, of the Shasta National Forest, Junior Range Examiner Johnson and other Forest Service employees, Captain of Game Wardens S. R. Gilloon and game wardens Brice Hammack, Jordan, Kehrer and Starr. These men all agreed upon the practicability of the program and considered the study vital at this time. It is a pleasure to acknowledge the endorsement of and promises of assistance to our study program that Supervisor Jones and members of the Forest Service provided at this meeting.

The following is the study program that has been adopted:

I. Areas.

To be carefully selected to present average conditions of different types of country within mule deer range. Thus one area should present semidesert conditions, another pine-juniper associations, another mountain pine timber, etc. Each individual area should be selected to incorporate, as far as it is possible within its bounds, all types of country (associations) occurring in the general vicinity. For instance, a pine timber area should include the average amount of brush and open meadow land and water that occurs in the general vicinity. "Work areas" *must not* be selected because they are known to harbor either greater or lesser than the average number of deer in the vicinity. In other words, each Work Area should, as far as it is possible, be selected to present average conditions of its general vicinity. It is of course obvious that some of the areas should be located in known "summer range" and others in "winter range."

Following are some vicinities suggested for consideration to locate Work Areas in. It is believed that most of the important different types of country contained within Modoc County can be found in these localities:

- A. Red Rock Valley. (Semidesert type with juniper.)
- B. Crowder Flat vicinity. (Pine, juniper, mahogany association.)
- C. Warner Mountains. (Mountain, pine, brush associations.)
- D. Little Hot Spring Valley. (Lava bed type.)
- E. Adin Mountain. (Pine, quaking aspen association.)

II. Censuses.

Two types of censuses will be made by the workers. In each case, the counts will be made as closely coincident as possible, preferably on succeeding days. As far as it is possible, censuses by all workers should be made on the same day.

A. *Number and date of censuses.* Four deer counts will be made each year.

1. *Winter count* designed to be made at *end* of fall migration, or when *all* deer are on their winter range. Date nearest to January 10 when satisfactory weather conditions obtain.

2. *Late winter range census.* To be taken at as late a date in spring as seems positive to still find *all* deer on their winter range. Probable date for this census, first half of April. (*Note:* By subtracting this count from "1" we should be able to figure the "winter loss." This count should provide about the minimum deer population for the year.)

3. *Fawn census.* To be made late enough to be certain to include all fawns (after latest fawns are walking), yet as early as possible. Suggested date, last half of July or August 1. (*Note:* This census should provide the maximum deer population.)

4. *Prehunting season census.* To secure number of deer immediately before hunting season opens. Date September 10. (*Note:* By subtracting number of fawns counted in this census from number counted in census "3," fawn loss may be estimated, except loss of very small young impractical to count, lost prior to census "3," on Work Areas. This will provide "hunting loss" by subtracting same from buck census here obtained (census "4") potential breeding stock may be computed.)

B. *Kinds of censuses.*

1. *Strip count.* Not to be made in Work Area but to be taken over a definitely laid out course, preferably circular, either in the general vicinity of the Work Areas or on some other desirable tract of land. This count will be taken four times a year as above, each time over exactly the same course, by the same observer or observers and at the same time of day. In different years, each count should be made on corresponding days. The length of the route in this count will necessarily vary with the type of country in which it is to be taken according to the ease or difficulty with which deer may be counted (open versus brushy or timbered country) and with the number of animals to be counted. The course should be as long as it is practical for a man to cover carefully in a full half day, or 5 or 6 hours, perhaps 4 to 6 miles.

When definitely selected, each "Strip Count Route" should be carefully laid out, marked (blazed, etc.) and mapped.

2. *Definite area count.* Each area should be carefully selected as outlined in Part I and its size determined in accordance with the requirements of this census. These areas will comprise the Work Areas. Each should be as large as possible, and yet conform with the following requirements: that, by any devisable means, the man in charge may, alone, count with almost full accuracy within a given time, *every* deer within its confines. Here, just as in the case of the Strip Count Route, type of country will greatly affect the size of the Work Area.

C. *Census requirements.* Workers will arrange to segregate age classes of deer and record each separately as follows (in each individual seasonal count):

1. Number of old (adult) does.
2. Number of yearling does.
3. Number of does with single fawn.
4. Number of does with twin fawns.
5. Number of fawns. (Deer of the season to be counted as fawns, i.e., April census fawns will be approximately 10 months old. These animals will be recorded as yearlings in the July census, when a new fawn crop will have appeared.)
6. Number of spike bucks.
7. Number of forked-horn bucks. (Notes if possible on same that have or lack "eye-guard" or "brow-tine.")
8. Number of bucks, three-pointers or better. (Notes wanted on exceptionally large bucks, ones with malformed or deformed antlers, etc.)
9. Special data as follows are desired for bucks only in the censuses indicated:

- a. January census: Number of bucks with shed antlers.
- b. April census: Number of bucks still carrying antlers.
- c. September census: Number of bucks in "velvet."

At the end of each census report, each worker should provide a statement of remarks upon the particular count in which especial emphasis should be given to the following points:

10. *Weather at census taking time*, clear or cloudy, rain or snow falling, depth of snow on ground. Brief statement of the weather at this point for the previous ten days. Temperature. Wind velocity and direction.

11. *General condition of the herd*, noting all exceptional cases such as unusually poor animals, condition and color of pelage (coat) and antlers, visibly diseased or injured animals. Each of the latter cases should be recorded in some detail.

III. Predatory animals.

The following methods for studying these animals and their effect upon deer are suggested for the use of the game wardens only. D. D. McLean is preparing more comprehensive methods for the use of the trappers on the game refuges.

A. *Secure estimated number of predators* (mountain lion, bear, coyote, bobcat, possibly golden eagle) occurring on Work Areas monthly. In reports indicate which of these animals and quantity thereof appear to be resident on the area, and which are only visitors and approximate extent of visit of each. This information to be secured by:

1. Observation of the predators in life.
2. Observation of tracks, especially in snow.

B. *Effect of predatory animals upon deer.*

1. By observation determine if harassment by predatory animals drives deer from their feeding, resting or watering places or disturbs them and to what extent in (a) feeding, (b) watering, (c) resting.

2. By observation of deer kills use every method possible (tracks, evidence, etc.) to ascertain the cause of each kill. In monthly reports list all kills found on Work Areas, also ones definitely attributable to

predatory animals that are found elsewhere, and in both cases provide all details.

C. At all seasons, workers should be on the alert to note especial conditions (such as deep snow, storm, extreme cold, or heat, etc.) under which predatory animals become particularly or more than ordinarily harmful to deer. It must be emphasized here that we have little exact information relative to the effect of predatory animals upon deer. We wish to particularly stress this phase of the work and the need for care in executing it. All information must be positive or it is worthless; if there is a doubt in a case, express degree of same in your report; if the degree of doubt is large, better state "cause unknown" than to attempt to ascertain it from too scanty evidence.

D. Stomachs of all predators shot or trapped should be labeled as to date, locality and conditions under which same are secured and sent into the office for examination. However, only in extreme cases where the death of numbers of deer would result, should predators be removed from the Work Areas, because if they are, it will defeat the purpose of this study, which is to learn what happens to our deer under *natural* conditions.

IV. Disease, parasites, poisons.

A. In the case of live deer that are visibly diseased, same should be studied as closely as possible for symptoms which should be recorded, but only in the case of badly diseased or incapacitated animals should they be killed. All deer carcasses found, whether or not on Work Areas, if fresh enough to permit of observation should be carefully examined for the following diseases, symptoms of which are provided herewith. Each case should be reported in detail with locality in monthly report.

1. *Bacillus necrophorus*, or, "calf-diphtheria." Symptoms already known to most game wardens consist of highly inflamed, often mucous filled throat or gullet, mouth, nasal passages or other head areas. The best way to inspect a specimen for this disease is to slit the mouth back from the rear corner of the lips to the neck, open the mouth wide and examine it, especially in back of the tongue and the throat. If these areas or parts of them are inflamed, show a mucous discharge or are greenish-white in color, it is fairly safe to assume that the animal had "deer disease," as this malady is locally termed. When such diseased heads are found they should be sent in for examination.

2. *Liver fluke*. Remove the liver. If it has a blotchy, speckled appearance with whitish blotches or mottlings on its surface, then the animal most probably suffered from this disease, and its liver should be sent into the office for confirmation. Sometimes the fluke can be found as a thin whitish or reddish leaflike structure. If the examination shows a normal, healthy colored liver, that has one or more watery welts about the size of a dime on its surface, the presence of these "cysts" do not indicate liver fluke, but these are the larval stages of the dog tapeworm. This condition is very common among our deer, but is apparently harmless to them except in rare cases of extreme infestation. However, record should be made of all deer livers found to be so affected.

3. *Lung worm*. Cut the lung open. If it is infested with lung worms, these parasites will be seen as coiled whitish or gray strings on close examination.

4. *Pink-eye*. Pus, mucous discharging and inflamed eye or eyes are good indicators for this disease. In such cases, cut off and send in for examination animal's entire head.

5. *Bot larvae*. The larvae of the bot fly are frequently found in the nasal passages of deer. In most cases, the presence of these "grubs" do not appear to affect the animal's health at all. However, some cases of severe infestation are on record that have caused either great incapacitation or even death in deer. To examine an animal for bot fly larvae infestation, cut open the front of the head from nose to eyes and expose the sinuses, or nasal passages. If bot fly larvae are present, they will readily be seen as they are grayish oval or short "cigar" shaped grubs varying from one-quarter to one inch in length. Specimens (entire

deer heads) need not be sent into the office for examination in cases of moderate or light bot fly infestations; but a record of the presence or absence of this parasite should be included in the report upon each carcass examined. In cases of heavy infestation, where examination fails to reveal other diseases or causes for death, and bot larvae is the suspected cause, then the animal's entire head should be sent into the office for examination.

General instructions regarding disease. Inspect each carcass for all the above enumerated diseases. The finding of a single disease in itself is not sufficient as the same animal might be suffering from two or more maladies, any one of which or a combination of all might have been responsible for its death. Only in cases where parts are thought definitely to be diseased should they be sent to the office; but in such cases, we do want to receive the affected parts as explained above, except that livers are not wanted that are infected with dog tapeworm cysts only, unless they are unusually heavily infested, nor are the heads bearing but moderate bot larvae infestations desired. Workers are cautioned to thoroughly wash hands and clothing if soiled after making examination or handling a diseased carcass. Wash contaminated parts thoroughly and repeatedly with soap and water. Do not handle food or pipe before washing hands that have been soiled by examining a diseased deer. If "black-leg" is suspected to affect deer, rubber gloves should be worn before touching a diseased carcass and all precautionary measures exercised, as this disease is very dangerous.

B. External parasites: Deer are subject to more or less infestation by fleas and ticks. Usually the animals seem to suffer little or no harm, save possible annoyance from these pests. However, an occasional (usually a poor) deer is found that is very heavily parasitized, particularly by ticks. It is only in such cases of extreme infestation that the workers need direct attention to these parasites when the extent of infested areas should be noted together with visible effect upon the animal. Specimens of the parasites should also be preserved in small bottles of alcohol, labeled, and sent in for determination. It should, however, be borne in mind that cases of heavily parasitized deer occur rather as a result of, rather than as a cause, of sickness. Usually some disease or malnutrition gets the deer's condition down so that it can not combat the parasites that normally live on it, then they multiply enormously. Therefore, all cases of heavily parasitized deer should be investigated further for sickness or other ailments.

Mule deer workers should look carefully in cases of bucks examined for evidence of emasculation through tick bites. There is a popular opinion that many bucks lose their masculinity from this cause and definite information is desired in its regard.

Occasionally deer may be found to harbor lice, in this event specimens of the mites are desired by the office, preserved in alcohol and accompanied with full data as to host, locality, etc.

C. Poisons. Full data and stomachs for analysis are desired of all deer suspected of having died from poison. Particularly note the poisonous shrubs or plants in your vicinity and endeavor to ascertain by observation whether or not deer eat them and if so, their effect upon the animals. Certain vetches and wild parsley are among the plants that are sometimes poisonous to live stock and we desire information relative to their effect upon deer, if the animal eats them.

V. Mortality.

A. In the Work Areas the cause of the death of all deer is desired if it is possible to ascertain. Workers should patrol each area thoroughly at least once a month in search of carcasses. When a dead deer is found, every possible means should be resorted to to determine the cause of mortality. Report should be made separately on each dead deer found and incorporated in monthly reports. If it is impossible to ascertain cause of death, carcass should be listed and cause shown as "unknown." It is of utmost importance to record the age and sex of every dead deer in the report.

B. Reports are also desired of dead deer and cause of their mortality that are found by the game wardens on areas other than the Work Areas in the course of their regular patrol duties. These reports, however, should be made separately and each should be plainly marked to preclude any possibility of its becoming confused with the Work Area report.

C. Following are some causes of death in deer:

1. Winter kill (starvation).
2. Predators.
3. Hunting (means will later be devised for securing an accurate record of legal hunting kill on Work Areas).
4. Illegal hunting.
5. Wounded deer lost by hunters that die.
6. Accidents (natural accidents, not man-caused, such as falling off cliff, snagging self in brush, etc.).
7. Old age.
8. Disease.

VI. Food and Water.

This is one of the most important parts of the investigation. It embraces the relation of our deer herd and live stock and the need of water. It is also one of the most difficult phases of the study upon which to secure definite, unassailable information. It is, therefore, urged that all workers devote especial emphasis to this portion of the study and endeavor to assemble a mass of pertinent facts in this regard.

A. Ascertain actual food of deer on your area by observation (watching them eating) and record list of deer food plants in their order of preference (seasonally) or give percentage figures for food plant preference. Range Examiner Johnson, of the Forest Service, is an expert botanist, familiar with most of the forage plants in the mule deer section. He will cooperate with the workers and familiarize them with the common and important food plants.

B. Note and report from time to time in monthly reports as observations are made, the effect that deer browsing has upon the food plants. Necessarily some of these observations should be made in areas free from live stock or at a season when live stock are not present. Consider the possibility of fencing off small plots in grazed areas to exclude live stock, yet permit access of deer for use as study plots in comparison with the surrounding area.

C. Note and report as above what other animals feed upon the same plants as the deer and their effect upon same.

1. Other wild animals (antelope, rabbits, squirrels, etc.).
2. Cattle and/or horses.
3. Sheep (domestic).

D. Note and report as above what plants cattle and sheep feed upon that deer do not eat, and effect upon same.

E. Take photographs illustrating good food growth, poor growth and cases illustrating where good deer browse has been destroyed by fire, drought, grazing or other causes. "Before and after" photos are particularly desired.

VII. Migration.

Secure all possible data relative to the migration of deer in your vicinity, especially on and to and from the Work Areas. Provide this information in the monthly reports. The following are some considerations by which to be guided in this phase of the study.

- A. Dates of commencement of migrations (spring and fall).
- B. Dates of height of same.
- C. Dates of conclusion of same.

D. If there are more than the two definite annual migrations, such as a mid-winter migration, caused by deep snow, lack of food or some other factor, record and report same.

E. Note direction of migration travel.

F. Note time migrating is done, by day or night or both.

G. Attempt to ascertain distances migrated (distance from summer to winter ranges).

H. Ascertain range of individual deer (recognizable individuals such as bucks with distinctive antlers, animals with malformed hoofs, etc. Consider possibility of marking deer, ear tagging or marking fawns for instance, for this purpose).

1. By day or week.
2. In a year.

VIII. Habits.

There is relatively little *exact* information available regarding the habits of deer. Many hunters have quite definite opinions in this regard that vary enormously. We must, by this study, secure a mass of absolutely reliable and true information on the subject. This should be done by each worker bearing the following suggestions in mind at all times, making notes or field observations of same and incorporating them in the monthly reports. Following are points regarding the "Life History" or "Habits" of mule deer upon which we particularly desire information at this time:

A. Date of commencement of rut.

1. Date when bucks start "running."
2. Date of actual mating. Age classes mating. Do yearling bucks and does breed? Do very old individuals breed?

B. Dates upon which bucks drop antlers.

1. Note earliest date annually upon which first buck with shed antlers is seen.
2. Note dates when most bucks on your area shed antlers.
3. Note latest date in spring when buck with antlers is seen.

C. Dates upon which "velvet" is shed.

1. Exact dates of each instance where buck is seen in process of losing velvet, i.e., shredded velvet clinging to antlers. In each case also note color of pelage or coat at the time.

D. Following information must be recorded regarding fawns:

1. Date upon which earliest fawn is noted in spring.
2. Date upon which latest new born fawn is noted.
3. Dates between which most fawns are dropped.
4. List dates of all fawns noted so young they can not run.
5. All yearling does with fawns must be specifically recorded.

E. Any reliable information obtainable (in the case of statements of hunters, etc., provide name and address of same with date upon which statement was secured) upon the following questions:

1. How long do deer live? (Known positive individual examples.)
2. How do deer "get along with" sheep, cattle or horses when these animals occupy the same range? In feeding? At water? Proven examples of specific cases on this subject should be obtainable and should be secured from reliable persons in the form of signed statements.
3. Are there any black-tailed deer in your mule deer range? If so, provide map of range, show area inhabited by each species and note approximate percentages of each kind's abundance.
4. Are there any hybrid (mule x black-tail) deer in your mule deer range? Provide information in this regard as above.
5. Do deer eat bronco grass? If so, does it cause lesions in their mouth or throat? Does overgrazing land by live stock increase the bronco grass crop? Does fire do the same?
6. Is brush-land increasing or decreasing in your vicinity? If decreasing, is it being replaced by conifers? Effect of same upon deer population.
7. Distance deer range from water (cite examples of deer killed known distances from nearest water). How often do does water? Bucks? How does this vary seasonally, or with hot and cold weather?
8. Do deer show a preference for some water over other? Do they drink at sheep or cattle troughs or tanks? Do they refuse certain mineral or muddy water?
9. Do deer use certain mineral springs or salt licks? If so, send in sample of water or salt for analysis with notes regarding extent of use by deer.
10. Effect of "salting" (placing salt artificially for live stock or deer) upon deer? Their use or refusal of same?

11. Information is desired in regard to the trend of the deer herds population in years past. How abundant were deer in your area 50, 40, 30, etc., years ago? Date of "peak" of deer abundance in your vicinity? Dates of low ebb in deer population your vicinity. (Get signed statements from old residents regarding this.)
12. Is the number of deer in your vicinity increasing or decreasing at the present time? (Statements from reliable persons solicited.)

IX. Conclusion.

A. *Maps.* Prepare a map of your general vicinity of sufficiently large scale to enable plotting upon it, so another could locate without your help.

1. Strip Count Route.
2. Work Area.

Prepare larger scale map of Work Area showing in detail all topography, tree, brush, meadowland and water. Be prepared later to mark upon this map, locations of deer, predators, etc.

B. *Reports.*

1. Strip Count Census which is to be made four times a year shall be reported separately immediately following each count.
2. Work Area reports, including reports of the four annual censuses on these areas, and all other information requested in this outline shall be rendered monthly. Prepare and forward these to the office as soon after the end of the month as possible.

C. Time expected to be devoted to this work.

1. *Strip Count Census.* One day on dates designated, 4 times a year.
2. *Work Areas.* Days required for four annual censuses, plus at least 3 to 4 full days per month, preferably more time, at workers' convenience, to be devoted to studying predators, habits, food, searching for dead deer, etc.

The above outline should be self-explanatory. The purpose of the Strip Count censuses is to secure a broader cross-section of the makeup of the whole deer herd (proportion of age classes and sexes) than would the counts on the smaller Work Areas provide. It is believed that these counts over a period of years may well be expected to indicate the trend of the deer population for the entire region.

At the time that this paper goes to press, Work and Strip Count areas have been selected and initial counts are scheduled to be made on them on or about January 10, 1934. This will mark actual commencement of the study which will be closely followed throughout the year and most probably also in one or two succeeding years, until the desired information is obtained.

The author wishes to acknowledge with thanks the assistance rendered him in the preparation of the range map here provided (Fig. 15) by the following Division employees: J. S. Hunter, S. R. Gilloon, Wm. Lippincott, C. O. Fisher, P. Kehrer, L. E. Mercer, F. R. Starr and C. O. Elliger.

CALIFORNIA FISH AND GAME

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PERSONNEL CHANGES IN BUREAU OF EDUCATION AND RESEARCH

On October 10, 1933, the resignation of Leo K. Wilson as Chief of the Bureau of Education and Research became effective, to permit him to accept a partnership in the law firm of McClymonds and Wells. Mr. Wilson originally came to the Division of Fish and Game on December 10, 1929, as a publicity man. He was made successor to Dr. Harold C. Bryant, on July 1, 1930, and continued his work as editor of CALIFORNIA FISH AND GAME.

The Fish and Game Commission has chosen Dr. J. O. Snyder to succeed to the responsibilities of the Bureau of Education and Research in addition to his duties as Chief of the Bureau of Fish Culture. The Bureau of Education and Research will retain its identity, and will continue to operate under a separate budget, under the supervision of Dr. Snyder.

Accompanying the changes just noted, James Moffitt has been placed upon full time with the Bureau of Education and Research, and under the supervision of Dr. Snyder will be responsible for the routine work of the Bureau, and will also act as editor of CALIFORNIA FISH AND GAME.

With the high professional standing, and the friendly and untiring interest of Dr. Snyder in our conservation problems, the sportsmen of the State are assured of a continuation of the fundamental scientific and educational work which should accompany a proper conservation program.—*John L. Farley, Division of Fish and Game, San Francisco, December 12, 1933.*

NEW FISH AND GAME CODE

The new Fish and Game Code which was adopted at the fiftieth session of the California Legislature and is known as Chapter 73, Statutes of 1933, became effective August 21, 1933.

This code embodies all the former Penal and Political Code sections relating to fish and game. The text of the code is clearly worded and the subjects are grouped together so that the average individual can refer to any game law that he desires to look up with greater ease than was possible in the case of our old law books. Everyone seems

to agree that the new code is a great improvement over the former compilation of our fish and game laws.

Copies of the new Fish and Game Code are available, and may be secured from the Division of Fish and Game at the price of 25 cents each.

The code is published in booklet form, size 5 $\frac{3}{4}$ by 8 $\frac{1}{2}$ inches. In addition to listing all the active sections of the Fish and Game Code, there are also provided in smaller type original sections that were later amended by the 1933 Legislature.

The code is completely indexed and a map showing the fish and game districts is included.—*James Moffitt, Division of Fish and Game, San Francisco, December 21, 1933.*

REGULATIONS GOVERNING IMPORTATION OF CERTAIN WILD BIRDS AND ANIMALS

In accordance with the duties imposed upon it by Chapter 76, Statutes of 1933, the Division of Fish and Game has prepared, and has on hand for free distribution to interested persons, a pamphlet known as "Rules and Regulations Governing the Importation of Wild Birds and Animals into the State of California and Conditions Under Which Same May Be Kept in Confinement."

This pamphlet was prepared by the Bureau of Education and Research in cooperation with the State Department of Agriculture. It lists the species of birds, mammals, crustaceans and mollusks, the entry of which into California is prohibited by this law. Certain species which may be admitted to the State under permit are also listed, and proper form for application for such permit is provided. Next, regulations are provided for the destruction of excluded species if found at large in the State, and conditions under which species imported under this act may be kept in confinement.

The officers responsible for enforcing this act are the fish and game wardens, the State plant quarantine officers and the county agricultural commissioners.

Birds or animals that are held captive in accordance with this act may not be liberated in the State.

The pamphlet closes with a description of some of the birds and animals covered by this act. In all cases, descriptions are accompanied by pen and ink drawings of the species, which were prepared by D. D. McLean, of the Division.—*James Moffitt, Division of Fish and Game, San Francisco, December 21, 1933.*

C. W. A. WORK TO AID DIVISION ACTIVITIES

California sportsmen are to reap much benefit from the Civil Works Administration program. Approval has been given by Captain Edward Macauley, engineer for the C. W. A., providing for the expenditure by the Federal government in California of upward of \$100,000 on fish hatcheries, egg-collecting stations, game farms and refuges.

This work will provide employment for more than 300 men. Some of the projects call for 750 days divided between 32 men. The Division of Fish and Game furnishes all materials.

Needed repairs to hatcheries, new roads, new brood ponds, new fences, receiving and aging tanks, all badly needed in the hatcheries, will thus be provided under the program. On the game farms and game refuges necessary improvements will be speeded.

This Federal aid will help enlarge the Friant small-mouthed black bass experimental ponds where more tanks will be added. At Mount Shasta, Forest Home, Burney Creek, Fall Creek, Basin Creek and Brookdale the work will enable hatcheries situated in these localities to increase their output of trout.

Work contemplated on the game farms at Yountville and Chino will enable them to produce more game birds.

Each project will have a supervisor in charge, selected from the locality in which the project is located.—*O. L. Warner, Division of Fish and Game, San Francisco, December 21, 1933.*

COMMERCIAL FISHERY NOTES

SARDINES

During September a general strike of all northern (Monterey and San Francisco) sardine fishermen occurred. The fishermen claimed that under the existing price of \$6 a ton it was impossible to make a living, so they struck for \$8 a ton. Dissatisfaction of many of the fishermen fishing for the outside floating reduction plants was made known, they claiming that short weights were being given them by the outside plants. After many conferences between canners and fishermen, and after the N. R. A. board, State Labor Commissioner, and finally T. A. Reardon, State Director of Industrial Relations, were called upon to mediate the claims, the strike was settled on October 20, with a price of \$7 per ton, after the Director of Industrial Relations had been selected as arbitrator.

Several new canning and reduction plants are planning to operate this season in the northern half of the State. The Bayside Fish Flour Co. has commenced operating its new plant at Point Richmond. A new plant at Pittsburg, the Pittsburg Canners, Inc., has installed machinery in a bean warehouse on New York Slough and started operations. The Benicia Canning Co. has thought of operating as a sardine cannery but to date has taken no fish.

For the first three months of the season (August, September and October), 52,377 tons of sardines have been delivered; 227,650 cases of 1-lb. ovals and 37,440 cases of other sized cans have been packed, as compared with 41,349 tons received, 81,328 cases of 1-lb. ovals and 1872 cases of other sized cans for the same period last year (1932).

SARDINE ABUNDANCE

True to the predictions made the early part of the sardine season by the California State Fisheries Laboratory, sardines in Monterey Bay and off of San Francisco have been relatively scarcer than in the fall of 1932. Knowledge of the sardine population, gained through continual study and sampling of the catch, was the basis for this prediction. No new abundant year class has entered the sardine fishery in three years. As a consequence, the sardine fishery has been supported in the fall by the existing older year groups. Naturally, the

sardines in these groups would decline in abundance when they are heavily fished, if no new supply of younger fish augmented the existing population. This has been the case. Also true to the predictions, a new group of small sardines was apparent in the first catches made off San Pedro after the season opened on November 1, with the smaller fish predominating in numbers over the larger and older existing groups.

MACKEREL

The California mackerel catch this year (1933) will be the largest of any season. In 1929 the catch was 57,974,000 pounds and this year, at the end of October, the catch was in excess of 60,000,000 pounds and will probably exceed the 70,000,000-pound mark by the end of the year. The greatest bulk of this catch is landed at San Pedro and San Diego, and most of the fish are canned.

During October, Fish Bulletin No. 40, "The California Mackerel Fishery," was received from the printer. This bulletin gives an account of the mackerel fishery throughout the world but particularly of the fishery in California in all its aspects, from the fish in the ocean to the final labeled can on the consumer's shelf.

FISHERIES CODES

Various organizations and industries in the fisheries of the State have been at work preparing their codes of fair competition under the N. R. A. or C. R. A. The State Fisheries Laboratory has been able to aid the various groups in compiling statistics of catches of various species of fish and the prices paid per pound, for their use in presenting codes for adoption. In San Francisco the wholesale dealers have presented a code for the wholesale dealers of northern California to the C. R. A. under which they will operate.—*N. B. S.*

FRESH FISH MARKETING

In its campaign to educate people to eat more fish and to try the various varieties of the sixty or more that are taken from California waters, the Division of Fish and Game has participated in exhibits and given demonstrations to over a million people since September 1.

With the heavy drain on the six or seven popular table fish threatening a depletion, it is the purpose of the Division to show the public that there are dozens of other kinds of salt water fish that are equally tasty and which furnish just as high a percentage of iodine and other valuable food elements as do salmon, bass, sole, sand dabs, barracuda, halibut, smelt and yellowtail.

The exhibit of the Division of Fish and Game represented Monterey Bay, with animated scenes of moving fishing boats and fishermen repairing nets. Two large educational signs showing statistical information of the importance of the fresh fish industry of California and "Reasons Why You Should Make Tuesday Fish Day Too" were posted in the center of the exhibit.

Pamphlets giving the food value of sea foods and our cookery book "Five Hundred Ways to Prepare California Sea Foods" were distributed free to interested housewives.

Demonstrations on methods of preparing and serving fish were given at various meetings. California newspapers maintaining home economics departments and household editorial pages are cooperating by publishing and demonstrating fresh fish recipes, in an effort to create a greater consumer acceptance and demand for California sea foods.—*A. A. Alstrom, Division of Fish and Game, San Francisco, December 21, 1933.*

KLAMATH RIVER SPAWNING CONDITIONS IN 1932

The season of 1932 was the occasion of an unusually large migration of salmon into Klamath River. It presented also a temptation to take eggs for artificial propagation in excess of hatchery facilities. Fall Creek Hatchery, the only plant for salmon propagation in Klamath River, has a safe capacity for 3,000,000 eggs. A larger number, possibly 4,000,000 may be received, but in that case, crowding becomes entirely too severe for safety. At this time, then, something over 4,000,000 eggs were taken and the racks, still crowded with fish, were opened.

Selected female fish to the number of 1302 were spawned, and an estimated number of 9154 were allowed to continue their migration and spawn naturally. There has been some question as to whether the bed of the river above the Klamathon racks presented a sufficient number of suitable gravel bars to accommodate any number of spawning fish, and also whether the tides caused by the power plant at Copco are destructive to eggs if such are deposited in the gravel of the bars.

Two assistants, Charles F. Moore and Kenneth E. Sullivan, were detailed by Earl Leitritz, foreman of the Fall Creek Hatchery, to determine by actual observation just what happened after the racks were opened. Work was begun November 4 and continued until December 1.

The observers covered the river between the racks and the dam and they also examined Fall, Jenny and Bogus creeks. They worked independently, and their excellent notebooks agree in the main in their findings.

Spawning beds were numerous; 25 or so measuring from 60 to 900 feet long and of various widths, were mentioned in particular. Upwards of 200 nests were examined. Many pairs were seen spawning—2811 dead fish were counted by one observer, 2226 of which were in Fall Creek. This mortality was largely the natural result of spawning and bore no relation to the condition of the river.

Most of the spawning operations are restricted to gravel bars which are left exposed at low water, and where the drainage is so complete as to destroy the eggs. In many cases, the sudden rise of the water whipped out the disturbed gravel of the nests and completely destroyed them. There are no spawning beds in the river above the mouth of Fall Creek as the channel is mostly in solid rock, although many salmon (300 or more) were found there. Jenny Creek is not fit for spawning; Bogus Creek was too roily for examination; Fall Creek was overcrowded. Dead salmon were frequently found in situations where they had been caught by falling water and perished before they were able to finish spawning.

Both observers conclude that although many young fish may come from natural spawning above the racks, there is great destruction as the result of varying levels of the river water. If fairly constant water levels were maintained, much natural spawning might be permitted in that part of the stream.

It follows that the plant at Fall Creek should be enlarged until it is capable of caring for all of the eggs that might usually be taken at the Klamathon racks. With ample justification for expansion there, improvements are being made as rapidly as funds will permit. The improvements are of such a nature as not to become obsolete in the event of the erection of a high dam somewhat farther down the river.—*J. O. Snyder, Division of Fish and Game, San Francisco, November 1, 1933.*

REPORT ON BLACK BASS PROPAGATION WORK

One year of actual experimental work in the propagation of small-mouth black bass has been completed by the Bureau of Fish Culture, and a brief summary of its accomplishment is of interest.

At the outset it may be noted that the artificial propagation of this particular fish is generally conceded to be one of the most difficult, hazardous and expensive of any which confronts the fish culturist, and further that at no place has its culture gone very far beyond the experimental stage. Moreover, we are attempting the work here in the west far from the native habitat of the species, and in a region where it does not at present thrive well in nature.

In the propagation of this bass, certain difficulties present themselves.

First, eggs can not be collected from wild fish and artificially fertilized as in the case of trout. Brood fish must be held under semi-natural conditions and allowed to pair and spawn over gravel nests in brood ponds.

Second, the newly hatched bass begin to take food when they are but a fraction of an inch in length. They do not thrive on artificial food, and hence microscopic animals must be provided in large quantities and at the proper time for the little fish. When these small bass attain a length of an inch or so, they demand other small fish as food, and if not provided they will eat one another.

Third, black bass are voracious and cannibalistic so that large and small fish may not live together. Grading and sorting are difficult.

Fourth, brood fish must be provided with live food or they will become diseased or barren.

It then becomes the business of the bass grower to be able to propagate not only the bass themselves, but also several other species of minute crustacea and fishes as well, and have them present in sufficient quantities at the proper time. It is evident also that to accomplish all this requires the services of a competent naturalist, particularly in a region where nothing of the sort had been previously attempted. The Bureau was fortunate in having a well qualified man in its employ and any success that has been achieved is due largely to the untiring efforts of the present foreman, Merrill W. Brown.*

* Doctors G. C. Embury, H. S. Davis and P. R. Needham and other recognized experts in the propagation of bass have been frequently consulted.

Through the friendly cooperation of the Fresno Sportsmen's Club and Harold K. Fox, its president, a site was procured free of charge in a deserted gravel pit near Fresno and adjacent to the San Joaquin River. The construction consisted of a series of dirt ponds holding about eight acres of water. There was a stock pond, a spawning pond and seven rearing ponds. In addition, six small concrete daphnia ponds were built. Pipes which supply water and afford drainage were connected with the river. An electrically driven pump formed a part of the equipment, and a small pump house served as a laboratory.

Leakage soon developed and two of the larger ponds had to be abandoned. Further leakage also causes an unexpected amount of pumping and it also seriously interferes with proper fertilization of the brood ponds.

Fertilization of the water is required to produce an abundant growth of single-celled algae (minute green plants) upon which daphnia or other microscopic animals may feed. The latter serve in their turn as food for the little bass. Brown found after much experimentation that a mixture of soy bean meal and acid phosphate produced the best fertilizer. He also discovered that the hot climate was unfavorable to daphnia, a minute crustacean commonly used for food in the east, and that a very similar little animal known as moina could be propagated as needed.

In the process of casting about for suitable fish food of larger size, red shiners were brought from San Diego, goldfish, mosquito fish, native minnows and sunfish were experimentally propagated or studied. At last, it fell to the lot of the bluegill to do its part, and now these fish of all sizes and ages are available for the always hungry bass.

In short, a system of propagation has been experimentally established by means of which a food supply depending upon a chain of complex operations is made available under the particular climatic conditions of the location.

Various pests have appeared to deplete the pond fish—herons, large and small, kingfishers and mergansers. A handy shotgun, more noisy than efficient, kept these at bay, but it seemed unwise to use it on the biggest and worst offender, a local angler caught red-handed. At one time, countless numbers of tadpoles hatched out and seriously threatened the supply of moina which was intended for the small bass.

The actual expenses incurred in the year's work amounts to \$4,138.62. This includes supervision and labor (foreman and part-time assistant), supplies and miscellaneous charges—not a great deal when everything is considered. About 40,000 fish were hatched. Six thousand eight hundred seventy-six bass measuring $2\frac{1}{2}$ to 3 inches were planted in favorable situations where future observation is possible. Two thousand three hundred fifty of these were successfully shipped to the region of San Diego, 520 miles, to test the possibility of long distance transportation. The loss at the ponds is largely traceable to cannibalism, which was difficult to control as the hatching extended over an abnormally long period. Extremes of temperature occurring over short intervals of time interrupted hatching and destroyed fish.

The net results are a carefully established background for future work and a demonstration that small-mouth black bass may be propagated here.—*J. O. Snyder, Division of Fish and Game, San Francisco, November 20, 1933.*



FIG. 15. 1914-15. Shooting of large number of game. Mr. L. L. Kelly, Manager, San Francisco, California, is in the center of the group. (Courtesy of the California Game and Fish Commission.)

LARGE-MOUTHED BLACK BASS INTRODUCED INTO LAKE MERCED *

A planting of large-mouthed black bass in Lake Merced, San Francisco County, which is used as a storage lake for the municipal water supply of San Francisco, was made on October 28, 1933. This introduction was sponsored by the Associated Sportsmen of California and is in keeping with the policy of the Fish and Game Commission to plant fish in bodies of water in the State where public fishing will result.

Two hundred and twenty cans of these fish were netted under the direction of George Neale, in charge of the Bureau of Fish Rescue, in the upper Sacramento Valley sloughs. They were transported to San Francisco by motor truck under the care of game wardens of the Division. Not a fish was lost from the time they were taken from the river waters until they were released in the lake. Some of the bass weighed as much as eight pounds, and none were less than one-half pound in weight. This supply of brood stock will be added to until some 2000 large-mouthed bass will have been planted in the lake.

These bass are prolific spawners and develop quickly, therefore, it is expected that within the next three years the lake will be well stocked with this species of game fish. Until they increase in numbers and size, the lake will be closed to angling.—*O. L. Warner, Division of Fish and Game, San Francisco, November 15, 1933.*

FIRST CALIFORNIA PHEASANT SEASON A SUCCESS

California's first open season on pheasants is now history.

During the six-day period, November 15 to 20, when these great upland birds could be legally hunted, more men went out in the fields to try their luck than have fared forth for any other small game in many years.

While no exact figure could be obtained as to the number of male birds that were killed during the season, 20,000 seems to be a fair estimate. This figure is based on reports of game wardens who kept a careful check on all hunters and their kill, questioned sporting goods dealers and devoted much effort to ascertain the success of the open season in every section where pheasants were hunted.

The wardens' reports revealed many interesting facts. A great number of sportsmen and some of our field men figured there would be a veritable slaughter of these birds because they were becoming so tame and domesticated. But it appears that the cock pheasant is a very wary bird and well able to take care of himself. He soon got it through his head that the report of a shotgun meant no good for him when his native, wild instincts asserted themselves and he surprised many a shotgun wielder with his speed in flying and running, his deceptive flight, and his ability to hide and back track on the nimrod.

* The 14th Biennial Report of the State Board of Fish and Game Commissioners for the years 1895-1896, p. 30, reveals that in June, 1895, the Spring Valley Water Company planted 300 large-mouthed black bass in Lake Merced. These fish were procured from the East by the Fish Commission.—Ed.

After the first day, it was quite a feat for a hunter to get his limit of two birds, and many had difficulty in getting one in sections where the birds were plentiful.

Women seemed to take great interest in hunting pheasants and the wardens noted many in the field.

Very few female birds were killed.

Northern and central California were the centers of the most successful hunting.

The interest in this new sport in California is indicated in a report by Warden Charles Sibeck, who patrolled the delta region of the Sacramento Valley. One excerpt reads:

"Quail and dove seasons draw many hunters to the delta country, but on opening day of the pheasant season, men and women bought licenses to hunt these birds, making up the largest army of hunters I have ever seen."

Andy Hamilton, Redding, who has for years been active in the introduction and propagation of pheasants in that vicinity, kindly provided his personal reactions to the pheasant season in that vicinity which are quoted here:

"The sportsmen are well satisfied that they have a real game bird in the pheasant, and one that can take good care of himself, under any conditions. Unfortunately, Shasta County has a comparatively small area suitable for pheasants, but what area we have is ideal and the birds seem to multiply rapidly.

"There was quite a difference of opinion as to how many birds were killed in this vicinity. It is my opinion that about 1000 birds were killed. To get this estimate, I personally contacted 90 hunters who on 146 trips killed 362 birds. These were only the hunters who came in my store."

August Bade, Superintendent of State Game Farms, says there are some million pheasants in California. The kill of 20,000 would seem to present no problem of depletion. Most of those who followed the season declare that it will be beneficial to the birds left, that they will not be so tame and will revert to the cunning that has made them an outstanding game attraction in other States.

Landowners seemed to enter into the spirit of the occasion, and but few refused permission to hunt on their property if courteously asked.

Wardens reported the following kill of pheasants in these areas: Sacramento delta section, 1360 birds; Yuba, 500; Antioch, 1200 to 1500; Vallejo, 500; Los Angeles and Chino, 1000; Redding, 1000; Owens Valley, 300; Santa Clara and Alameda counties, 350; Tule Lake, over 1000; Bayshore, below Redwood City, 200; Modesto, 450; Tehama, 250; Napa, 300; Humboldt and Mendocino counties, 400.—*O. L. Warner, Division of Fish and Game, San Francisco, December 20, 1933.*

1933 QUAIL SEASON

The 1933 quail season seems to have been* "spotty" throughout the State. Early reports indicated that in southern California where these birds are not as plentiful as they used to be, the hunting was excellent, and experienced quail hunters had no trouble getting their

limits. As the season progressed, the birds scattered and locating them became more difficult.

In central California, hunting was said to have been good, and the best success was had by those who used trained dogs.

In the northern areas, where quail have been plentiful in previous years, the sport was not as excellent as in the past.

Little complaint was heard from sportsmen about the reduced limit, and those who hunt with dogs thought that the six-week season was about the proper length.

Band-tailed pigeons gave the hunter more sport this season than they did last. In localities where these birds are to be found, they were extremely numerous in 1933 and most hunters who went after them were successful in taking limits.—*O. L. Warner, Division of Fish and Game, San Francisco, December 20, 1933.*

OREGON ADOPTS UPLAND GAME BIRD LANDOWNER CONTRACT LAW

The State of Oregon has recently enacted a new piece of fish and game legislation that will be of interest to California upland game bird hunters. This act provides the "set-up" for carrying out the sportsman-landowner cooperative shooting system lately advocated by so many game authorities. We understand that this act has been in effect for but a short time and that, as yet, no actual contracts have been undertaken.

The following excerpt from the Oregon Game Code provides the text of this measure:

SECTION 30. Game Script—Issuance—Contracts with landowners.

(a) The game commission hereby is authorized to enter into contracts with any landowner, his lessee or managing agent in any county of the State of Oregon by the terms of which contract the game commission shall issue to anyone holding a current hunting license, or combination hunting and fishing license, script or coupons at a price not to exceed 50 cents, which coupon or script shall entitle, subject to the provisions hereof, the person to whom same is issued, to go upon any land of any owner thereof who has contracted with the game commission for the purpose of taking Chinese or Hungarian pheasants or any other of the upland game birds during the open season and within the lawful bag limits therefor. And it shall be lawful for the owner of such land or his lessee or managing agent to collect from such hunter one coupon for each of such birds taken on the land of such landowner, his lessee or managing agent and the game commission is further hereby empowered to redeem any of such coupons at and for a sum not exceeding 90 per centum of the amount for which the coupons were originally sold to the licensee.

The provisions of this act shall inure to the benefit of any and all owners of land, their lessees or managing agents, desiring to take advantage thereof in any county or counties of the State of Oregon where the game commission shall declare said script may be used, but nothing herein contained shall be deemed or construed to require the game commission to provide for the use, sale or redemption of such script in each and every county in the State of Oregon.

The game commission hereby is authorized to promulgate such further rules and regulations as is necessary to carry out the intent of this act.

(b) The game commission shall furnish to all landowners, their lessees or managing agents, appropriate signs to be posted by such persons on lands subjected to the provisions of this act.

(c) Nothing herein contained shall be construed to prevent any landowner, his lessee or managing agent from limiting the number of said game birds killed on his land by limiting the number of persons allowed upon his land during any day, week or hunting season.

(d) Any person who shall counterfeit any hunting script issued by the game commission or who shall alter same shall be deemed guilty of a felony and, upon conviction thereof, shall be sentenced to pay a fine of not less than one hundred dollars (\$100) nor more than five thousand dollars (\$5,000), or to imprisonment in the penitentiary for a period of time not exceeding five years or by both such fine and imprisonment.

Here in California, our present game laws require no legislative action to permit the operation of the sportsman-landowner cooperative shooting system. Legal advice has ruled that the existing Fish and Game Code contains authority for the Fish and Game Commission to undertake similar contracts to those above described.

Several sportsmen's organizations, notably the Associated Sportsmen of California and numerous chapters of the Izaak Walton League, are vitally interested in the development and working out of a similar plan in this State.

The state-wide Fish and Game Committee of the California State Chamber of Commerce has had functioning for some time a subcommittee on quail projects which has particularly concerned itself with the possibility of developing the sportsman-landowner cooperative plan in our State. Progress toward the end of preparing a workable scheme for use in California is reported by this subcommittee.

The Fish and Game Development Association is another California organization that is intensely interested in the possibilities of the sportsman-landowner movement for the improvement of upland game bird shooting in our State. This progressive organization has continuously advocated the establishment of "trial areas" in which to test out the mechanics of operation of the system. It is hoped that actual operation of at least one trial area may be effected within the near future in order that we may have early proof of the adaptability of the system to California conditions.—*James Moffitt, Division of Fish and Game, San Francisco, December 4, 1933.*

WATERFOWL ABUNDANCE IN CALIFORNIA IN 1933

In spite of dire prophesies to the contrary, the 1933 fall flight of waterfowl in California seems to have been considerably in excess of the 1932 flight. At the time this note is written, there yet remain ten days of the 1933 season and, in the absence of reports from other areas, it is therefore too early to draw definite conclusions. Perhaps the large numbers of ducks and geese that have been observed in California this fall present a concentration here, but this fact can not be determined until reports are available from other Pacific Coast States.

There seems, however, to be no doubt whatever that ducks were more abundant in California during the present season than in the previous year. The Division has made particular effort to secure reports from reliable individuals in the various waterfowl concentration areas of the State, and in most instances these reports indicate more birds in 1933 than in 1932.

The writer was at Tule Lake, Siskiyou County, November 28, when this body of water was still open, and in fact just commencing to freeze at its margin. No doubt, a similar open condition existed in most of the lakes of that vicinity and eastern Oregon. This fact, the result of a warm fall in contrast to an unusually cold one a year ago, per-

mitted many thousands of ducks and geese to remain on the lakes of the higher plateau region. At this time, there were thousands upon thousands of ducks on Tule Lake in addition to myriads of geese, and State Game Warden Fred R. Starr stated that ducks were much more numerous there than at any time in the previous season.

Several sources have consistently reported more ducks in the Butte Creek Basin region of the Sacramento Valley this year than a year ago. This, in spite of the fact that weather conditions as above outlined permitted large numbers of the birds to remain in the plateau region that were unable to stay there so late a year ago.

Suisun Bay and marshes, and the South San Francisco Bay marshes have had more ducks on them in 1933 than in the prior season.

Early this season, water was, as usual at this time, short in the San Joaquin Valley. In spite of this fact, ducks are reported to have visited this section in greater numbers this year from August to date. Several gun clubs from this region have reported more successful kills throughout the present season than were obtained a year ago. Large numbers of ducks were reported in the San Joaquin Valley in September and October, and on the opening of the season, November 1. Fair shooting was had in this region in November, but less success was had during the first two weeks in December. Storms occurring about mid-December brought in a large number of new birds, particularly widgeon, teal and shovellers, to the San Joaquin Valley, and excellent shooting is reported from that area after December 16.

Several observers in the Wasco-Delano section of northern Kern County report more birds there this year than last. Similar reports emanate from the Lancaster-Palmdale region and from the Imperial Valley.

When figures from our neighboring States are available, we hope that the above encouraging reports will not indicate an undue concentration of ducks in our State, but will show that the duck crisis has passed and that the birds are commencing to regain their former numbers.—*James Moffitt, Division of Fish and Game, San Francisco, December 21, 1933.*

DEER TAG RETURNS FOR 1933

Tabulation of deer tags places the number of bucks killed during the 1933 open deer season in California at 17,689. This is 691 less than the number legally taken in 1932. The decrease in 1932 over 1931 was 7425, over ten times the decrease of the current year.

Tags sold during 1933 totaled approximately 94,500 a decrease over last year of about 2200.

In noting the decrease in the number of successful hunters, the fact must be considered that in game districts 4 and 4 $\frac{1}{2}$, the season was five days shorter than normal this year, due to the fact that the law changing the season in this area to the period August 16 to September 15 did not become effective until August 21. Therefore, the deer season in districts 4 and 4 $\frac{1}{2}$ did not open until that date and, of course, had to close on September 15.

The 1933 tags returned show that there were 556 less deer bagged in San Bernardino, Los Angeles, Riverside, Orange, San Diego and Imperial counties than in 1932. Los Angeles County this year returned

571 tags against 819 last season; Riverside, 354 against 488; San Diego, 173 against 363; San Bernardino, 153 against 187; Orange, 36 against 87. Imperial County showed an increase of one, there being five deer killed there this year.

In Tulare County, there were 104 less deer killed than last year; El Dorado, 92; Glenn, 97; Siskiyou, 86; Trinity, 78; Placer, 77.

The following counties registered the greatest gains: Monterey with 104; Inyo, 116; Kern, 67; Plumas, 83; San Luis Obispo, 59 more deer killed in 1933 than in the previous season.

Two thousand fifty-seven hunters succeeded in getting their legal limit of two bucks.

The highest five counties, with Mendocino leading, as it has done for years, are: Mendocino, 1233; Modoc, 954; Plumas, 912; Fresno, 882; Humboldt, 838.

Other counties which turned in over 200 tags include: Siskiyou, 823; Sonoma, 745; Monterey, 631; Los Angeles, 576; Lassen, 551; Santa Barbara, 547; Shasta, 517; Lake, 481; San Luis Obispo, 436; Ventura, 354; Trinity, 340; Marin, 301; El Dorado, 368; Inyo, 296; Napa, 281; Kern, 263; Madera, 266; Colusa, 222; Butte, 205.

The following figures show the size of the deer killed during the past season:

Two-pointers, 7417; 3-pointers, 5298; 4-pointers, 2453; 5-pointers, 370; 6-pointers, 58; 8-, 9-, 10-, 11-, 12- and 14-pointers, 2021. There were ten 10-pointers, two 12-pointers and two 14-pointers reported killed this year.—O. L. Warner, *Division of Fish and Game, San Francisco, December 20, 1933.*

DEER AS CARRIERS OF A CATTLE DISEASE

That deer may harbor a certain disease of cattle and possibly serve as a means of spreading this infection is the conclusion reached by two investigators, William H. Boynton and Gladys M. Woods of the Division of Veterinary Science, University of California.

This cattle disease, anaplasmosis, is considered by many to be due to a minute animal, called a protozoan, which appears as a dot in the red corpuscle of the blood. Because of its dot-like appearance, it has been named *Anaplasma*, a Greek term meaning "without protoplasm." This pin-point organism breaks up the red corpuscles of the blood, thereby causing anemia and jaundice, the principal symptoms of anaplasmosis or "*Anaplasma* infection."

Through the assistance of Ronald P. Harville, two deer, a mule buck and a southern black-tailed buck, were furnished the investigators by the Division of Fish and Game. Both were injected with blood containing the tiny organism, *Anaplasma*, but neither showed any symptoms of anaplasmosis, and although a few "dots" resembling *Anaplasma* were observed in the red corpuscles of the mule deer, they were too few to justify a positive diagnosis. However, when blood was taken from the southern black-tailed deer and injected into two cattle, one of them became infected and exhibited symptoms characteristic of anaplasmosis. Blood taken from the mule deer and inoculated into two cattle caused death in both cases, with symptoms and lesions typical of the disease. This proves that infection was present in these deer even though no definite sign of the disease appeared. Animals which

harbor infection without showing any evidence of it themselves are called "carriers."

Now that deer are proved to be "carriers" of anaplasmosis, how can they be a menace to cattle? The fact that anaplasmosis is a blood infection means that blood from a "carrier" animal must be introduced into a susceptible one in order to produce disease. By what means can the blood of deer be transmitted to the blood of cattle? A ready answer is: "insects." Previous discoveries of other investigators indicate that certain ticks and blood-sucking flies may transmit the disease through their bite. It is possible that these flies may attack deer; some of the ticks, at least, which were found on the two deer under investigation are among those proved to be transmitters of the disease. Since these ticks may first bite "carrier" deer, drop off, and crawl onto cattle grazing in the vicinity, biting them in turn, and thereby injecting the causative agent into the cattle, there is always a chance of spreading anaplasmosis in this manner—a possibility that should receive further attention.—*W. H. Boynton, Division of Veterinary Science, University of California, Berkeley, November 15, 1933.*

ANOTHER "NEW" DEER FOR CALIFORNIA

I. McT. Cowan's work on Pacific coast deer was outlined in the October issue of CALIFORNIA FISH AND GAME (Vol. 19, p. 274), where his description of a new subspecies of mule deer from the Inyo region was mentioned.

The November, 1933, issue of the *Journal of Mammalogy* (Volume 14, pp. 326-327) contains the description of another "new" subspecies of mule deer from California. To this deer, Cowan has bestowed the name *Odocoileus hemionus fuliginatus*. The type specimen was secured on the Barona Ranch, 30 miles east of San Diego, October 8, 1928, and was taken by Webb Toms, who was a State Game Warden at that time.

Cowan provides the following range for the new subspecies: "From San Jacinto and Santa Rosa Mountains, Riverside County, and San Mateo Valley, San Diego County, California, southward at least to La Corona, Sierra San Pedro Martir, Lower California, Mexico." Thus the new subspecies inhabits San Diego and southern Riverside counties in California, and the northern portion of Baja California.

Cowan's paper provides no vernacular name for the new deer, so it seems advisable to call it the San Diego mule deer because its range is in the so-called San Diegan faunal district.

This new mule deer is evidently most closely related to the California mule deer (*Odocoileus hemionus californicus*) and is of the same size. The San Diego mule deer differs from the typical California mule chiefly in its much darker coloration, being, in fact, the darkest of all mule deer. This darkness is not a slight one, but is extremely noticeable, and it is remarkable that the fact was not observed long ago.

Cowan had 16 specimens of the San Diego mule deer available for his study, one of which, from the Santa Ana Mountains, Orange County, showed a close approach to the California mule deer, hence it is probable that the subspecies intergrade in that vicinity.—*James Moffitt, Division of Fish and Game, San Francisco, December 20, 1933.*

DEATH OF BUCK DEER RESULT OF FIGHTING IN RUT

Many hunters believe that all buck deer live until they are shot and give little or no allowance for the number of deer that die each year from natural causes or accidents. That the latter factor is responsible for the death of a considerable number of our male deer annually is beyond question. Many types of fatal accidents may occur to deer.

For instance, this summer, Captain of Game Wardens S. R. Gilloon, of Mount Shasta, was called upon to autopsy a spike buck that was found in a dying condition near Volmers, Shasta County. The supposition was that this deer was suffering from an infection known as *Bacillus necrophorus*, or "calf diphtheria." It was brought into Delta by a government truck where it died, and where Captain Gilloon later autopsied it. He found no indications of the above mentioned disease, but ascertained that the deer's stomach was ruptured, which, no doubt, accounted for its death. This accident could have occurred by the deer having been hit on the highway by an automobile, or by its having fallen off a cliff.

Another accident of a different character was brought to my attention during the past deer season. Some sportsmen of my acquaintance were hunting deer with dogs west of Boonville, in Mendocino County, on September 10, 1933. The dogs ran a three-point buck for some distance and then bayed it. One of the hunters approached the animal quite closely in an endeavor to account for its unusual behavior, for it is unknown for dogs to bay an unwounded buck. The animal presented all appearances of having been wounded, so the man killed it, and on approaching it, he noticed a deep wound in the thorax, or what is generally termed, the "sticking place." Skinning the animal later revealed that this wound was unquestionably caused by the animal running into a snag while attempting to escape from the dogs. Undoubtedly deer may so occasionally snag themselves when frightened from causes other than hunters.

Another type of accident that it appears may be more common than the lack of reports of same would indicate is the death of bucks caused by their fighting in the rutting season.

Game Warden J. W. Thornburg, Jackson, California, has kindly provided us with the following notes of his observations in this regard:

During the winter of 1931 to 1932, while stationed at Summit Camp, on the Salt Spring-Tiger Creek conduit of the Pacific Gas and Electric Company, in El Dorado County, I had unusual opportunities to observe the numbers of deer that were wintering in the vicinity.

One day in the latter part of November, 1931, I was driving up the road from Summit Camp to Bear River Intake and had taken several photographs of the many deer along the road. On rounding the turn near Beaver Creek, I was forced to apply my brakes so that all four wheels of the car locked in order to avoid having a head on collision with two beautiful four-point bucks that were battling in the road.

One of these deer leaped from the road to the upper bank, and after retreating for about 30 feet, stopped and turned around. The other animal ran a short distance up the road and then also went on up the upper bank. As soon as this last animal was above the bank, the first buck started after him with bowed neck, hair along the back and shoulders bristling, and they resumed their battle. I had a front row seat for the show and watched it from my automobile at close range. What an opportunity I lost for photographs having used all my film previous to finding these deer.

I was amazed at the cleverness used by these animals in keeping themselves head on to one another in order to prevent one from getting in a broadside blow. Time after time, each buck was down on its knees, and like a flash he would be back on all fours. While down in this manner, his adversary would try to maneuver around in time to get a broadside blow at the other. There seemed to be no choice in size between these two bucks, but the one that left the road first seemed to be the stronger of the two.

I left these deer fighting and returned to meet Game Warden Vernon Sutton whom I told about the incident. We then returned to the spot where the deer had been fighting and walked about a hundred yards up the hill where we saw the two bucks, one of which was with a number of does, and the other about 100 yards to one side where he would watch for a few minutes, and then start after the bunch of does. The other buck would let him come within 50 yards of the females when he would start to meet him, at which the outsider would turn back and quite evidently admit his defeat.

Two days later, at only a short distance from the location of this battle, I found a dead two-year old buck, well scarred and with a large hole punctured just behind his ribs. Close examination of his carcass showed many scars of the sharp points of antlers. There was a scar about three inches in length which ran deeper



Fig 17. Game Warden Welch and the buck that was severely wounded in a fight with another. Photographed at Kernville, Cal., November 29, 1933.

toward the puncture. On opening the carcass, I found that the intestines were punctured which apparently caused the animal's death.

On December 14, 1931, while patrolling the flume, some distance above Bear River, I found at an underpass, a large four-point buck that had evidently been in a terrific battle. He had deep scars all over his body, and was so crippled in the back that his hind legs were useless. He had dragged himself down the hill some distance from above the flume and was so weak he was unable to go any further. He had evidently been where I found him for a couple of days. On back-tracking this animal, I found the snow much torn up for some distance and all the evidences of a terrific battle.

The finding of these two deer that had unquestionably died of injuries sustained in fighting during the rut, seems to be proof enough to show that there are a considerable number of male deer that lose their lives each year from this cause. I believe that there are many more male deer killed by being gored, or by being otherwise injured in fighting during the rutting season than are killed by locked horns or antlers, cases of which have been reported. My reason for this contention is the fact that the antlers must be very nearly the same size, spread and shape in both animals in order that they may lock.

Game Warden Roswell C. Welch, Kernville, California, provides the following report of another instance of buck injury through fighting in the rut.

On Wednesday, November 29, 1933, I received a report that an injured deer had been found near Havilah by some C. C. C. men. Upon my arrival at the camp, the superintendent sent a couple of lads with me to point out the place where the deer was.

I found the deer to be a very large buck which had apparently been in a battle with another of his kind and had come out second best. One antler had broken off inside of the skull, and hung useless. There were two punctures in his side which had pierced his lungs. His body was covered with cuts and gashes. While still alive, it was plain he would soon die so we mercifully dispatched him and dressed the carcass in an attempt to save the meat.

Apparently, there had been a terrific encounter, as brush and small trees had been trampled and the ground had been torn up over a considerable area. There was all the evidence of a battle royal. This buck was extraordinarily large for this vicinity; his antlers had five distinct points on each side and several minor points which some would have counted, but I considered him a fine five-point buck.

It would have been interesting to have seen what this buck's adversary looked like, and I am wondering how he fared in the encounter, not to mention my curiosity as to his size.

The deer in this vicinity are at present right in the middle of the rut, which was the cause of this fight. Quite often, on patrol, I see evidence of battles in the torn up ground, and sometimes I see a couple of bucks fighting, but usually these fights are of short duration. One would be fortunate indeed to have been able to have witnessed this fight.

James Moffitt, Division of Fish and Game, San Francisco, December 4, 1933.

DEER FENCING LAW REPEALED

Chapter 732, Statutes of 1933, repealed sections 162 to 165 inclusive of the Agricultural Code. These sections included the so-called "Deer Fencing Law" which was enacted by the 1931 Legislature, and provided for State contributions toward the erection of deer proof fences to protect crops that were endangered by deer.

The section providing for the issuance of revocable permits by the Fish and Game Commission for the killing of deer upon evidence of their destruction of crops was not altered by the 1933 Legislature, but was merely reworded and is now section 1293 of the Fish and Game Code.—*James Moffitt, Division of Fish and Game, San Francisco, December 21, 1933.*

DEER HUNTING SUCCESS IN ANGELES NATIONAL FOREST

W. L. Sears, Acting Supervisor of the Angeles National Forest, has provided some interesting statistics relative to the number of hunters, cars and success of hunters entering the Saugus District of that national forest during the first three days of the 1933 deer season as compared with the previous year. This information was compiled by Ranger M. W. Durham of the Saugus District and is printed here through the kindness and permission of J. W. Nelson, Assistant Regional Forester, U. S. Forest Service.

Sears remarks that "there is a reduction in numbers [of hunters] under that of last year which is due, most likely, to the change in the dates of the opening of the season, there being two seasons in adjoining

districts now open at the same time, which gives us a better distribution of hunters."

The following is a compilation of Ranger Durham's figures:

	1933	1932	Loss or gain
Total number of automobiles-----	782	1,097	315 loss
Total number of hunters-----	822	1,531	709 loss
Total number of persons-----	2,078	2,531	453 loss
Total deer killed, first 3 days of season-----	105	85	20 gain

Thus, in 1933, 822 hunters killed 20 more deer than did 1531 hunters in the same area in the previous season. In 1932, only one hunter out of every 18 was successful in this area while the following year nearly one hunter out of 8 bagged his buck.—*James Moffitt, Division of Fish and Game, San Francisco, December 21, 1933.*

SHELDON'S DEER OF CALIFORNIA

A paper covered booklet of 72 pages entitled "The Deer of California," by H. H. Sheldon, former Field Naturalist with the United States Bureau of Biological Survey, was issued as Occasional Paper No. 3 of the Santa Barbara Museum of Natural History, November 1, 1933. Copies of this booklet may be obtained from that museum at \$1.50 each.

This publication is printed on coated paper which provides excellent reproductions of the many illustrations that it contains.

The introduction informs the reader that this treatise is in answer to numerous discussions, stories, news items and arguments pertaining to the deer of California. Nevertheless, Sheldon states that considerable field work and comparative study is yet required to complete the final classification of California deer. The author notes that just as a knowledge of football increases the pleasure of watching the game, so does a knowledge of the game laws, characteristics and habits of the quarry add zest to the hunt.

He states that California harbors more varieties of deer than are found in any other State in the Union, and that our deer hold their own numerically by reason of the natural protection afforded by wilderness haunts, the reduction of mountain lions, and wise game laws protecting does and limiting the kill of bucks, and the establishment of numerous game refuges.

Following the brief introduction is a colored map showing the ranges of the kinds of deer occupying California, and following this map, the various species are described. These include the Rocky Mountain mule deer, California mule deer, burro deer, Columbian black-tailed deer, southern black-tailed deer and western white-tailed deer.

Sheldon's distributional map is a great improvement over Hall's similar one (see CALIFORNIA FISH AND GAME, vol. 13, 1927, p. 57). The ranges that the present author provides for California deer coincide fairly well with the ones outlined in Grinnell's recent work (see p. 87, this issue), but Sheldon more definitely defines the area along the western flank of the southern Sierra Nevada in which the Columbian black-tailed and California mule deer evidently meet and intergrade. His distributional map shows this to be slightly north of the Yosemite

region, which agrees with information at our disposal, except in that the area inhabited by deer of both species is probably larger than Sheldon's map indicates, for we have records of "good" black-tailed deer from the Yosemite Valley and Joseph Dixon has recently told us that he has seen specimens of true California mule deer from the western flank of the Sierras as far north as east of Sacramento. Sheldon's map indicates that the California mule deer ranges east across the southern Sierra in Kern, Tulare and Fresno counties into Inyo County. This treatment must now be modified in view of Cowan's findings and ascription of a new mule deer to the Inyo region (see CALIFORNIA FISH AND GAME, vol. 19, 1933, p. 274), so the California mule probably does not range east of the Sierra crest here or at any other point.

Sheldon's description of the California mule deer states that "the upper surface of the tail is centered with the dark median line of black following its length to the tip, and is edged with white" (p. 15), he also states that the white rump patch is much restricted as compared with that of the Rocky Mountain mule deer. This description agrees with Caton's original one of the California mule deer, the type of which was taken near Gaviota Pass in Santa Barbara County, and apparently the tails of all mule deer from this region have the dark dorsal median line. On the other hand, many examples of California mule deer from the western flank of the Sierra Nevada from the Yosemite region to Kern County and also, we understand, from the San Gabriel and San Bernardino mountains of Southern California, have pure white tails except for their black tips, lacking the dark dorsal stripe. Sheldon does not mention this fact in his text, but in the caption for the illustration of such a white-tailed mule deer, photographed in Sequoia Park, which appears on page 22 of his work, he draws attention to this fact and states that these deer come into this region from the Nevada side and meet the range of the California mule deer here. On page 25, he illustrates another deer from the same region which has a very narrow black dorsal tail stripe and avers that this is the result of intergradation between Rocky Mountain and California mule deer, adding that the dark median tail line is not sufficiently prominent to classify this deer as a typical California mule deer. The latter statement is doubtless true, but the reviewer can find nothing in Sheldon's work to support his statement that Rocky Mountain (now correctly Inyo) mule deer come west into this region and interbreed with the California form. We consider that California mule deer are variable as to this character and that in the center of this form's range more animals have white than black-lined dorsal tail surfaces. The preponderance of black-striped-tailed deer in the northern extremities of this form's range, southern San Luis Obispo and Santa Barbara counties on the west, Tuolumne and Mariposa counties on the east, *may* be the result of intergradation of this species with black-tailed deer. If such is proven to be the case, then the type of *californicus* can not be regarded as typical of the race if such a statement can be made, but it represents a borderline specimen indicative of intergradation with black-tailed deer. Perhaps a thorough study of this form will show that typical examples from the center of its range have white tails except for black tips. This hypothesis is simply pro-

vided as another explanation for the tail variability in this form, for the reviewer is loath to accept the theory that either Rocky Mountain or Inyo mule deer migrate west in fall to interbreed with California mule deer. It has been his experience that with the possible exception of very rare instances in Plumas, Lassen or Tehama counties, all Rocky Mountain mule deer winter east of the Cascade-Sierra crests.

Sheldon's descriptions of deer are accompanied by drawings of the ears of the various species, their hoofs and metatarsal glands, and the tails of the different species.

Next the author discusses the antlers of our deer, and among the illustrations there is one of a large set of antlers from a doe. Sheldon admits that the number of points on the antlers does not always indicate the deer's age, but he states that in general this fact is true. We believe that this statement might more properly be restricted to mule deer, for black-tailed deer seem to bear forked horn antlers more often than those with three or four points to the side. In this section, the author presents some X-ray photographs of the lower jaws of deer showing the teeth by which the animal's age can be ascertained with fair accuracy.

A short section on the glands of deer and one on their mating habits follow.

Next the author discusses some methods of deer hunting in which he brings out some interesting points in regard to the animal's habits. There follows an excellent section illustrating and describing the methods of skinning a deer and of preserving the head for a trophy. The uses of deer are then discussed and here an excellent method for preparing jerky is described.

A short section on predatory animals that prey upon deer follows and next a very brief discussion of the parasites that are harbored by deer.

The next section, entitled "The Pack Trip and How to Throw a Diamond Hitch," will probably be of most interest to campers, for the description and excellent illustrations describe better than we have seen attempted anywhere the method of throwing this excellent pack hitch.

The volume closes with a list of references to published literature on the various species of deer and predatory animals treated in this work.

We believe that Sheldon has prepared a most interesting and useful booklet that will be of entertainment and value to all California deer hunters, whom we urge to study it in its original form.—*James Moffitt, Division of Fish and Game, San Francisco, December 29, 1933.*

GRINNELL'S REVIEW OF CALIFORNIA MAMMAL FAUNA

A publication entitled, "Review of the Recent Mammal Fauna of California,"* by Professor Joseph Grinnell, Director of the University of California Museum of Vertebrate Zoology, was issued September 26, 1933. This paper consists of a short introduction and an account of all the mammalian species and subspecies known to occur, or to have occurred within the confines of this State up to the time of publication.

* Univ. Calif. Publ. Zool., Vol. 40, pp. 71-235, September 26, 1933. Copies may be purchased from the University Press, Berkeley, Calif. Price \$1.25.

The introduction advises that the first attempt to catalog California mammals was made by the pioneer California naturalist, Dr. J. G. Cooper, in 1868 when he listed 115 kinds of mammals for the State. Frank Stephens published in 1906 his "California Mammals" which listed 276 kinds. In 1913, Grinnell published "A Distributional List of the Mammals of California" (Proc. Calif. Acad. Sci., Vol. 3, pp. 265-390) which listed 337 species and subspecies. The same author in 1923 published a nominal list of 417 species and subspecies of mammals for California (Univ. Calif. Publ. Zool., Vol. 21, pp. 313-324). The author states that the present Review is in no sense to be considered more "final" than any of the similar preceding contributions and it may therefore be considered in the nature of a progress report upon the classification of mammals in the State.

The present Review lists 460 species and subspecies of mammals for California. The account of the species commences with the introduced Virginia opossum. The treatment of each species is as follows: First, its order, family and scientific name are provided, next vernacular name, then reference for the animal's original description. Type locality is next provided and then vernacular synonyms. The mammal's range in the State is then provided in some detail, including its altitudinal range and the life zones it inhabits.

Following the account of the opossum, moles, shrews and bats are treated. Next, two kinds of black bear and seven kinds of grizzly bear are ascribed to the State. The latter are all now thought to be extinct and the last positive record of a grizzly bear in California was for one shot at Horse Corral Meadows, Tulare County, in August, 1922. Fur bearers are next listed as follows: coons (3 kinds), ring-tailed cats (3), marten (2), fisher, weasels (6), mink (2), wolverine, river otter (2), sea otter, spotted skunk (7), striped skunk (4), badger (2), red fox, kit fox (3), gray fox (3), Island foxes (6), mountain, valley and desert covotes, and plains wolf. The last wolf taken in California was secured in Lassen County, in 1924.

The following cats are ascribed to California: the Mexican jaguar, which historical evidence indicates once occurred as far north as the region between Monterey and San Francisco, two kinds of mountain lion and four wild cats.

We learn from this review that California waters are, or were once, inhabited by two kinds of sea lions, the Pribilof and Guadalupe fur seals, the California harbor seal and the elephant seal.

Grinnell presents a novel, but doubtless logical, innovation to lists of mammal fauna on pages 118 and 119 of the report when he lists the subspecies of man inhabiting the State. Four subspecies are recognized, the Causasian, American Indian, Mongolian and Negro. The author, in his account of the status of the Caucasian, provides the following, almost facetious, statement: "Nonnative, but now thoroughly established and spreading and increasing, chiefly by immigration, at an amazing rate. First came, as voluntary pioneers, in year 1769, settling in a few coastal localities. Increased but slowly until about 1850 when great numbers arrived from many parts of the world. Disposition aggressive and tendencies destructive, especially of natural habitats, as result of which much of native mammal life, including the endemic race of man (*H. s. americanus*), has been reduced; * * *"

The introduction advises that man is included in the list because he came into the State voluntarily. Domestic mammals are not included because man brought them in. On this basis, wild horses, which entered eastern California voluntarily, should be included and the Virginia opossum should be excluded from the list because man introduced it.

The order RODENTIA follows the order PRIMATES in which man is classified. Among the order RODENTIA, marmots, ground squirrels, chipmunks, chickarees, gray squirrels, flying squirrels, gophers, mice and rats are treated. Sportsmen will marvel at the fact that no less than 37 different kinds of gophers are ascribed to California, 31 kinds of pocket mice and 34 kinds of kangaroo rats.

The beaver and muskrat are members of the order RODENTIA and three kinds of beaver are ascribed to California, the golden beaver which inhabits the Sacramento and San Joaquin valleys, the Shasta beaver of the Pit River basin of northeastern California, and the Sonora beaver of the Colorado River and Imperial Valley. Two subspecies of muskrat inhabit California, the Nevada muskrat, which is native to the larger streams and lakes tributary to the Great Basin along the extreme eastern border of the State from Eagle Lake south to Mono County. Curiously, this rodent appears never to have been native in the basin of the Pit River. The Colorado River muskrat is indigenous to that river and since 1911 has spread into irrigation canals throughout the Imperial Valley.

The porcupine and coneys are included in the order RODENTIA. The following rabbits are ascribed to California: two kinds of white-tailed jack rabbit, or Sierra hare, two varieties of snowshoe rabbit, five kinds of jack rabbits, six cottontails, four brush rabbits and the Idaho pigmy rabbit of the Great Basin region.

Sportsmen will no doubt take greatest interest in the classification of the elk, deer, antelope, bison and mountain sheep which are members of the order ARTIODACTYLA. Two elk, the Roosevelt and dwarf, or tule, elk are native to this State. The former ranged from Marin County north through the coastal belt to the Oregon line and at the present day exists only in small numbers in Del Norte and northern Humboldt counties. The dwarf elk formerly occupied nearly the entire San Joaquin and Sacramento valleys and occurred in the southern coast ranges in San Luis Obispo, Santa Barbara, Monterey and Santa Clara counties. It has now been reduced to a herd of approximately 140 animals on the State elk refuge near Buttonwillow, Kern County, and several smaller herds that have been transplanted from this point. The eastern, or Canada, elk has been planted in California, and a small herd appears to be thriving in Shasta County and a lesser number of animals in Lassen County.

Two subspecies of black-tailed deer occur in California. The Columbian black-tailed deer ranges south from the Oregon line, from the coast east to the Sacramento Valley, south to the north side of San Francisco Bay. Grinnell states that this subspecies also occurs south-east along the Sierra to both sides of Mt. Shasta and Lassen Peak, at least south to the lower Feather River region on the west flank of the Sierra Nevada. The reviewer believes that more intensive study of the deer population of the western flank of the Sierra will show that

this deer occurs south at least into the Yosemite region. The southern black-tailed deer occupies the coast ranges from the south side of San Francisco Bay, south through Monterey and San Benito counties into northwestern San Luis Obispo County.

Four subspecies of mule deer are ascribed to California. The Rocky Mountain mule deer Grinnell properly ascribes to the northeastern corner of the State, but we think that his statement that this deer's range continues south through the main Sierra Nevada to Tuolumne County will not be borne out when more evidence is secured. According to our observations, the typical Rocky Mountain mule deer is a rather rare animal south of the vicinity of Truckee. South of that point, a few bucks appear to migrate each spring from Nevada westward toward the summits of the Sierra Nevada, and in the fall again return to the eastern deserts to winter.

The Inyo mule deer (see CALIFORNIA FISH AND GAME, Vol. 19, 1933, p. 274) occupies the eastern slope of the southern Sierra Nevada in Inyo and probably Mono counties.

Grinnell states that the range of a third subspecies, the California mule deer, extends west from the western margins of the Colorado and Mojave deserts, northwest from the Mexican line in San Diego County, through Santa Barbara County into San Luis Obispo County, and northeasterly from Ventura County through the Tehachapi and Piute mountains at least to the vicinity of Walker Pass. He states that this race probably occurs north along the western flank of the southern Sierra Nevada, and we feel quite certain that it is this subspecies that occurs northward in this region into the Yosemite region, in which region this deer seems to interbreed with the Columbian black-tailed deer, and probably even considerably further northward.

Reference to page 81 in this issue of CALIFORNIA FISH AND GAME will indicate that another subspecies of mule deer has been named from California and this new deer, the San Diego mule deer, occupies part of the southern range ascribed to the California mule deer above.

The burro deer is another subspecies of mule deer which Grinnell states occupies the Colorado desert region, north along the Colorado River, through the Chocolate and Chuckawalla mountains to the Granite Mountains, and, formerly at least, from the Mexican line south of Salton Sea through the Imperial Valley into central Riverside County.

Grinnell ascribes the western white-tailed deer to California on the basis of a very definite record of a buck taken in January, 1922, on Observation Peak, in eastern Lassen County. He also lists another, but not quite satisfactory, record for this deer from Topaz, Mono County, in 1930 (see McLean, CALIFORNIA FISH AND GAME, Vol. 17, 1931, p. 342).

Under the range of the prong-horn antelope, Grinnell advises that this species apparently occurred nearly throughout the State south and east of the humid coast belt and below the main timber line. Considerable numbers of antelope still exist in several separate bands in Modoc, Siskiyou and eastern Lassen counties. A small herd still occupies the western side of the San Joaquin Valley, four individuals are known to yet exist in Antelope Valley, Los Angeles County (see page 91, this issue), a small herd is said to exist in northwestern San Bernardino County, and a few individuals on the Colorado Desert

near the Mexican line in eastern San Diego, or western Imperial counties.

Many readers will doubtless be surprised to learn that Grinnell states that the Oregon bison without any doubt formerly occurred in the northeastern corner of California, where it apparently traversed the semidesert valleys of eastern Modoc and Lassen counties.

Four varieties of bighorn, or mountain sheep, are ascribed to California. The lava beds bighorn formerly ranged this region in the extreme northeastern portion of the State, where it is now thought to be extinct as the last individuals are said to have died in eastern Siskiyou County in the winter of 1913. The Sierra Nevada bighorn still occupies the higher portion of the southern Sierra from the vicinity of Mammoth Pass, Mono County, south to the vicinity of Olancha Peak, in Tulare County. Under this form, Grinnell notes that ascriptions of the mountain goat to this region of the Sierra Nevada are apparently erroneous and are now thought to have been based on the presence of bighorns. This author states that the range of the desert bighorn is in general the mountain ranges of the Mojave Desert and Inyo regions, north to the lower slopes of the White Mountains, Mono County, south to the Chocolate Mountains and west to the San Bernardino and San Gabriel mountains.

The fourth variety of mountain sheep treated in this Review is the Lower California bighorn, which occupies the mountains bordering the west side of the Colorado Desert from the Mexican line, northwest to the lower northern slopes of the San Jacinto Mountains, in San Geronio Pass. Considerable discussion has recently arisen regarding the number of sheep of this subspecies now inhabiting the State. Investigations by M. Hall McAllister, Edmund C. Jaeger and State game wardens seem to agree in that there are between two and three hundred of these animals now ranging in Riverside and San Diego counties.

Grinnell's account of mammalian species ends with the aquatic mammals, of which he lists nine whales, four porpoises, the dolphin, cowfish, killer, grampus and blackfish.

The paper closes with a very complete index.—*James Moffitt, Division of Fish and Game, San Francisco, December 22, 1933.*

THE PRONGHORN ANTELOPE IN LOS ANGELES COUNTY

This is a supplementary note to the account of the antelope of Antelope Valley, Los Angeles County, in the July, 1932, issue of CALIFORNIA FISH AND GAME (Vol. 18, p. 258). The antelope herd at that time was composed of seven individuals—one male and six females.

On December 3 of this year, 1933, I again found the herd in the rolling low hills of Antelope Valley five miles north of Sandberg and counted four individuals, all females. I followed the herd in my car across country for two miles and got as close as one hundred and fifty yards on several occasions by approaching slowly. At this distance field glasses brought them into good view for study. My partner tried to attract them by waving a red bandana in the breeze on the end of a stick, but though their curiosity was aroused to the extent of their standing still to look, they would not come toward us. They could probably see all they wanted to at one hundred and fifty yards.

Various ranchers of this region have seen these animals recently and they too have seen only four in the herd. Inasmuch as it would be improbable that a herd as small as seven would split, it appears that three individuals, including the one male, have met their deaths. At this rate of depletion and with no male in the herd, antelope in Antelope Valley will shortly disappear unless conservation forces can introduce more antelope to bolster up this rapidly disappearing herd.—*Harvey T. Anderson, Jr., Junior Assistant Fire and Game Warden, County of Los Angeles, December 7, 1933.*



Fig. 18. M. E. Beatty and the mountain sheep "mummy" *in situ* with shells replaced on horns. Photo courtesy National Park Service.

MOUNTAIN SHEEP FOUND MUMMIFIED IN YOSEMITE GLACIER

The Sierra Nevada bighorn, or mountain sheep (*Ovis canadensis sierrae*), has been rated as extinct in the Yosemite region for at least fifty years. That these animals once inhabited this area in fair number, is indicated by the fact that horns and fragments of skulls are often found by hikers in our high country.

On October 4, 1933, Park Naturalist C. A. Harwell and I were ascending the eastern slope of Lyell Glacier on our third annual

glacier measuring expedition. We paused at this point to regain our breath when I chanced to glance over to my right, where, to my great astonishment, I saw what appeared to be, at first glance, a living mountain sheep staring at us across the ice. I called Harwell's attention to this apparition when we immediately realized that the animal lacked both hair and horns, and in fact was a mummified specimen.

We discovered that the life-like position was due to the fact that the animal was supported in an upright position by a pedestal of ice that the body had shielded and thus prevented the sun from melting. The warm summer had melted the ice of the glacier sufficiently to expose all of the animal, with the exception of two of the feet.

The ram seemed to be in a perfect state of preservation, the flesh dried in the manner of "jerky"; the skin dry and taut as a drum's head. The missing horn shells were found with little difficulty in the moraine below, one at a distance of 30 feet and the other about 75 feet from the specimen.

A closer examination showed that the neck of the animal was broken, but none of the leg bones or other bones was broken. One front leg had come apart at the knee joint. We found the missing part intact near one of the horns, and we realized that we had discovered the first complete skeleton of a Sierra mountain sheep for the region.

After photographing the ram, we transported it, with some difficulty, to our base camp at Lyell Fork and ultimately back to Yosemite Museum where it is now being prepared for exhibition.

In attempting to piece together the story of the animal, it was found necessary to have more data, so a return trip was made with steel stakes and surveying equipment to measure distances and rate of flow of the glacier. We found that the glacier moved only one inch during a four-day period, or at the rate of seven and one-half feet per year. The ram was found 1936 feet from the head of the glacier. Now, assuming that the animal fed or was caught in a slide while feeding on the crest of Mount Lyell and was buried in the bergschrund, it would take close to 250 years for the glacier to carry the sheep to the spot where found. This great length of time is borne out by the aged appearance of the horns and the dehydrated flesh.

The animal shows a broken neck, probably sustained at the time of death, and a concave body, probably the result of varying ice pressure.

The only hair found on the body was directly back of the ears and in the folds of the neck.

This mountain sheep is a mature male specimen measuring 55 inches in length and 33 inches in height.

The circumference of each horn at the base is $12\frac{1}{2}$ inches, and the length of the horns along outer curve 27 inches. Judging from the growth rings on the horns, the animal was a 7-year-old.

The weight, as is, is 45 pounds.

National Park officials feel that this find is one of the most important discoveries of the year in the whole park system.—*M. E. Beatty, Assistant Park Naturalist, Yosemite, December 18, 1933.*

HERON CHOKED TO DEATH BY CATFISH

The accompanying photograph is of a black-crowned night heron (*Nycticorax nycticorax hoactli*) which was found dead at Hemet Lake, Riverside County, May 3, 1932. It had evidently choked itself to death in an unsuccessful attempt to swallow an eight-inch catfish, part of which can be seen protruding from the bird's mouth in the photo (Fig. 19).—J. H. Gyger, Game Warden, Perris, June 15, 1932.

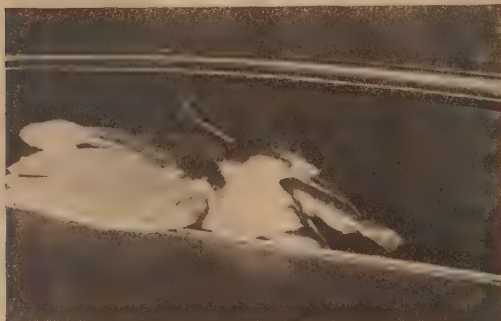


Fig. 19. Night heron choked to death by catfish, Hemet Lake, Cal. Photo by J. H. Gyger.

STATEMENT OF INCOME

For the Period July 1, 1933, to September 30, 1933, of the Eighty-fifth Fiscal Year

License sales	Detail	Total
Departmental income:		
Angling licenses, 1932.....	\$5,475 00	
Angling licenses, 1933.....	80,671 50	
Commercial Hunting Club licenses, 1933-34.....	125 00	
Commercial Hunting Club Operators licenses, 1933-34.....	20 00	
Deer tags, 1932.....	1,143 25	
Deer tags, 1933.....	21,976 00	
Fish Breeders' licenses, 1933.....	15 00	
Fish Importers' licenses, 1933.....	5 00	
Game Breeders' licenses, 1933.....	85 00	
Hunting licenses, 1932-33.....	8,181 18	
Hunting licenses, 1933-34.....	59,633 50	
Market Fishermen's licenses, 1933-34.....	16,620 00	
Trapping licenses, 1933-34.....	20 00	
Wholesale Fish Packers' and Shell Fish Dealers' licenses, 1933-34.....	680 00	
Total license sales.....		\$194,650 43
Other income:		
Contributions from importers.....	\$15 00	
Court fines.....	6,866 74	
Fish packers' tax.....	21,413 12	
Fish tag sales.....	100 50	
Game tag sales.....	42 27	
Interest on bank balances.....	1,220 61	
Income from Department of Agriculture Fund, Chap. 825-33.....	40,000 00	
Miscellaneous sales.....	64 75	
Publication sales.....	140 15	
Dividends California National Bank, 20 per cent.....	7,418 03	
Total other income.....		77,281 17
Total departmental income—current year.....		\$271,931 60

STATEMENT OF EXPENDITURES

For the Period July 1, 1933, to September 30, 1933, of the Eighty-fifth Fiscal Year

Function	Salaries and wages	Materials and supplies	Service and expense	Property and equipment	Total
Administration:					
Executive.....	\$2,089 98				\$2,089 98
Clerical and office.....	1,380 00	\$110 47	\$29 06		1,519 53
Automobile.....		69 93	19 10		89 03
Traveling.....			301 16		301 16
Postage.....			1,298 26		1,298 26
Telephone and telegraph.....			623 25		623 25
Freight, cartage and express.....			156 13		156 13
Rent.....			3,389 96		3,389 96
Accident and death claims.....			284 73		284 73
Accounting pro rata.....	1,125 00				1,125 00
Legal.....	493 56		43 56	\$28 40	565 52
Total administration.....	\$5,088 54	\$180 40	\$6,145 21	\$28 40	\$11,442 55
Bureau education and research:					
Chief.....	\$975 00				\$975 00
Clerical and office.....	480 00	\$25 81	\$8 77		514 58
Automobiles.....		107 81	26 95		134 76
Traveling.....			777 53		777 53
Postage.....			14 80		14 80
Photography.....			6 81		6 81
Freight, cartage and express.....			1 23		1 23
Library.....	270 00	3 48	6 00	\$16 20	295 68
Research.....	900 00	24 43		10 50	934 93
Publicity.....	750 00		9 00		759 00
Total bureau education and research.....	\$3,375 00	\$161 53	\$851 09	\$26 70	\$4,414 32
Bureau patrol and law enforcement:					
Chief and assistants.....	\$2,775 00				\$2,775 00
Clerical and office.....	795 00	\$9 79			804 79
Automobiles.....		2,116 27	\$1,722 81		3,839 08
Traveling.....			11,707 06		11,707 06
Postage.....			137 34		137 34
Telephone and telegraph.....			340 15		340 15
Freight, cartage and express.....			5 74		5 74
Rent.....			83 00		83 00
Captains and wardens.....	43,935 00	360 63	316 55	\$11 60	44,623 78
Launches.....		288 09	161 96		450 05
Fish planting.....	1,155 00	338 61	18 00		1,511 61
Cooks.....	375 00				375 00
Game refuge guard.....	90 00				90 00
Commercial fisheries patrol:					
Chief and assistants.....	690 00				690 00
Captains and wardens.....	3,465 50	50	6 16		3,472 16
Launches.....	2,518 55	561 27	56 96	6 00	3,142 78
Fish cannery inspectors—seasonal.....	1,130 33				1,130 33
Traveling.....			1,181 90		1,181 90
Rent.....			174 00		174 00
Automobiles.....		27 53	58 47		86 00
Temporary help.....	17 00				17 00
Total bureau patrol and law enforcement.....	\$56,946 38	\$3,702 69	\$15,970 10	\$17 60	\$76,636 77
Bureau commercial fisheries:					
Chief and assistants.....	\$3,405 00				\$3,405 00
Clerical and office.....	2,396 34	\$1 42	\$1 50		2,399 26
Automobiles.....		43 80	28 21		72 01
Traveling.....			1,294 62		1,294 62
Telephone and telegraph.....			114 55		114 55
Freight, cartage and express.....			5 79		5 79
Rent.....			24 19		24 19
Heat, light, water and power.....			44 81		44 81
Research.....	570 00	12 17			582 17
Laboratory.....	5,504 66	53 50	118 31	\$20 26	5,696 73
Statistics.....		21 94	504 00	12 42	538 36
Total bureau commercial fisheries.....	\$11,876 00	\$132 83	\$2,135 98	\$32 68	\$14,177 49

STATEMENT OF EXPENDITURES—Continued

For the Period July 1, 1933, to September 30, 1933, of the Eighty-fifth Fiscal Year

Function	Salaries and wages	Materials and supplies	Service and expense	Property and equipment	Total
Bureau fish culture:					
Chief and assistants	\$1,740 00		\$42 00		\$1,782 00
Clerical and office	1,020 00		1 50		1,021 50
Automobiles		\$1,145 36	327 08		1,472 44
Traveling			2,953 18		2,953 18
Postage			44 00		44 00
Telephone and telegraph			290 82		290 82
Freight, cartage and express			60 61		60 61
Rent			338 50		338 50
Heat, light and power			405 55		405 55
Hatcheries	27,155 46	14,329 69	469 52	\$45 21	41,999 88
Special field investigations				1 65	1 65
Fish cars	885 00	223 49	60 45		1,168 94
Blue printing			1 52		1 52
Cooperative research	795 00	98 14	633 26		1,526 40
Temporary help	161 00				161 00
Fish hatchery assistant—seasonal	8,365 76				8,365 76
Hydraulic engineering	600 00		263 05	29 21	892 26
Special field	1,834 98				1,834 98
Total bureau fish culture	\$42,557 20	\$15,796 68	\$5,791 04	\$76 07	\$64,220 99
Bureau game propagation:					
Chief and assistants	\$1,365 00				\$1,365 00
Automobiles		\$127 72	\$118 98		246 70
Traveling			525 78		525 78
Postage			27 01		27 01
Telephone and telegraph			28 58		28 58
Freight, cartage and express			17 96		17 96
Heat, light and power			480 45		480 45
Maintenance	3,164 71	1,344 13	78 81		4,587 65
Temporary help	243 43				243 43
Quail trapping and expansion of quail program	1,200 00	95 65	390 79		1,686 44
Total bureau game propagation	\$5,973 14	\$1,567 50	\$1,668 36		\$9,209 00
Bureau fish rescue:					
Chief and assistants	\$1,200 00		\$13 09		\$1,213 09
Traveling			134 76		134 76
Temporary help	13 00				13 00
Heavy truck service			190 90		190 90
Total bureau fish rescue	\$1,213 00		\$338 75		\$1,551 75
Bureau game refuges:					
Chief and assistants	\$2,124 99				\$2,124 99
Clerical and office	480 00		\$12 50		492 50
Automobiles		\$27 78	44 58		72 36
Traveling			868 78		868 78
Laborers	900 00				900 00
Lion hunters	1,177 00				1,177 00
Refuge posting	180 00				180 00
Predatory animal control			1,110 00		1,110 00
Refuge maintenance	1,140 00	391 47	271 41		1,802 88
Predatory animal hunters and trappers—seasonal	1,200 00				1,200 00
Temporary help—seasonal	885 00				885 00
Total bureau game refuge	\$8,086 99	\$419 25	\$2,307 27		\$10,813 51
Bureau licenses:					
Clerical and office	\$3,285 00	\$2 46	\$5 60		\$3,293 06
Traveling			1 00		1 00
Postage			240 50		240 50
Freight, cartage and express			75		75
Premiums on bonds			907 50		907 50
Total bureau licenses	\$3,285 00	\$2 46	\$1,155 35		\$4,442 81
Total 85th fiscal year expense paid from support appropriations	\$138,401 25	\$21,963 34	\$36,363 15	\$181 45	\$196,909 19

STATEMENT OF EXPENDITURES—Continued

For the Period July 1, 1933, to September 30, 1933, of the Eighty-fifth Fiscal Year

Function	Salaries and wages	Materials and supplies	Service and expense	Property and equipment	Total
Special items:					
Deer tight fences—Chap. 872-31, from July 1, 1933 to December 31, 1933.....					\$1,498 05
License commissions.....					7,131 25
State Fair and other exhibits.....					209 49
Total special items.....					\$8,838 79
Permanent improvements:					
Construction, improvements and equipment.....					\$3,793 88
Prior year expense:					
Eighty-fourth fiscal year.....					\$17,807 49
Bureau of commercial fisheries, Chap. 825-33					
Fresh fish marketing:					
Chief and assistants.....	\$495 47				\$495 47
Clerical and office.....	149 03		\$11 55		160 58
Automobiles.....			2 50		2 50
Traveling.....			105 80		105 80
Telephone and telegraph.....			66		66
Freight, cartage and express.....			49 23		49 23
Rent.....			1 15		1 15
Exhibits.....		\$99 84	2,013 70		2,113 54
Total bureau of commercial fisheries, Chap. 825-33 fresh fish marketing.....	\$644 50	\$99 84	\$2,184 59		\$2,928 93
Grand total proprietary group.....					\$230,278 28

SEIZURES OF FISH AND GAME

Juy, August, September, 1933

Fish:	
Abalones.....	306
Barracuda, pounds.....	54
Bass—	
Calico.....	45
Black.....	307
Striped, fish.....	251
Striped, pounds.....	531
White sea, pounds.....	500
Clams.....	115
Crabs.....	39
Catfish.....	17
Crappie, perch, sunfish.....	233
Lobsters.....	294
Salmon, pounds.....	451
Trout, pounds.....	556
Yellowfin, pounds.....	2,904
Sturgeon, pounds.....	20
Fish traps.....	11
Game:	
Deer.....	55
Deer meat, pounds.....	1,018
Ducks, geese.....	87
Doves.....	118
Pheasants.....	12
Quail.....	31
Rabbits.....	17
Shorebirds.....	1
Bear hides.....	2
Bear meat, pounds.....	100
Rifles.....	2

FISH CASES

July, August, September, 1933

Offense	Number arrests	Fines imposed	Jail sentences (days)
Abalones; small; overlimit	17	\$400 00	10
Angling; no license	24	430 00	10
Barracuda; small	1	5 00	
Bass—			
Calico; overlimit	1	25 00	
Black; small	3	10 00	
Striped	15	185 00	20
White sea	1	25 00	
Clams; small; overlimit	7	220 00	25
Crabs; small	13	165 00	20
Crappie; perch; sunfish; overlimit	7	165 00	
Commercial fishing; no license	47	110 00	
Lobsters; closed season	15	320 00	125
Salmon; overlimit; untagged	4	175 00	50
Trout; overlimit	10	325 00	
Yellowfin; small	3	25 00	
Operating set lines	1		
Night fishing	1		
Fishing too near mouth of stream and from fish ladder	5	75 00	
Fishing with too many poles	3	40 00	
Seines; nets; illegal use of	15	550 00	
Miscellaneous fish cases	4	40 00	
Totals	197	\$3,290 00	260

GAME CASES

July, August, September, 1933

Offense	Number arrests	Fines imposed	Jail sentences (days)
Deer; closed season; killing does, fawns; untagged deer	126	\$4,305 00	1,020
Bear; closed season	4	60 00	50
Ducks; closed season	11	200 00	5
Doves; closed season; overlimit	17	307 00	
Hunting; no license	67	1,157 00	2
Hunting in refuge	28	265 00	
Spotlight hunting	22	1,230 00	320
Killing non-game birds	2	35 00	
Pheasants; closed season	7	260 00	25
Shore birds; killing of	1	25 00	
Quail; closed season	10	195 00	120
Rabbits; closed season	5	110 00	
Trespassing	5	75 00	
Shooting from auto	9	125 00	
Totals	314	\$8,349 00	1,542

CALIFORNIA FRESH FISHERY PRODUCTS FOR THE MONTHS OF JULY, AUGUST AND SEPTEMBER, 1933

Compiled by Division of Fish and Game, Bureau of Commercial Fisheries

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Alameda, Contra Costa	San Francisco, San Mateo	Santa Cruz	Monterey
Albacore							91,080		407
Anchovy									29,605
Baracuda									
Bonito								10	
Carp		6,328			40	121			
Catfish					17,751	23,770			
Gulfus		58,733					50,273	14,301	27,957
Flounder		2,810					48,000	583	118
Flying fish									
Hake							1,750	479	13
Hallibut	840								
Hallibut—California									
Hallibut—Northern	120,253	24,025					2,353	1,515	5,482
Hardhead		2,735							
Herring									
Kelp Bass									
Kingfish									
Mackerel—Horse									37,252
Mackerel—Pacific								6,627	5,536
Mackerel—Spanish								2,135	786,955
Mullet									
Perch		1,475	2,892				22,179	3,424	9,709
Pompano								12	
Ray									
Rock Bass									
Rockfish	232,282	4,314						10	
Sablefish	87,943	613					105,415	167,551	207,382
Salmon	1,700,273	424,041	1,321	28,312			13,005	13,739	10,454
Sand Dab	85,778	1,285				89,073	144,925	964	6,466
Sardine							28,175		8,513
							9,262,198		61,252,054

[illegible]

All amounts shown in pounds unless otherwise specified. Skipjack and Albacore cleaned.

All amounts shown in pounds

BUREAU OF PATROL

E. L. MACAULAY, Chief of Patrol-----San Francisco
 K. P. Allred, Assistant Chief of Patrol-----San Francisco
 C. S. Bauder, Assistant Chief of Patrol-----Los Angeles

SAN FRANCISCO OFFICE

J. L. Bundock-----Oakland
 T. K. Duncan-----Concord
 C. E. Holladay-----San Jose
 M. F. Joy-----San Francisco
 McPherson Lough-----Palo Alto
 Forrest J. McDermott-----Santa Cruz
 C. R. Peek-----San Mateo
 Orben Philbrick-----Monterey
 Fred Post-----Salinas
 Lee C. Shea-----San Francisco
 J. P. Vissiere-----Watsonville
 W. M. LIPPINCOTT-----San Rafael
 W. J. Black-----Vallejo
 C. M. Bouton-----San Rafael
 C. L. Bundock-----Fairfield
 Chas. F. England-----Vallejo
 Bert F. Laws-----San Anselmo
 Geo. Smalley-----Antioch
 R. J. Yates-----San Rafael

A. H. WILLARD-----Sacramento Office
 Earl I. Hiscox-----Auburn
 Ray O'Connor-----Grass Valley
 Nelson Poole-----Sacramento Office
 Albert W. Sears-----Placerville
 Chas. Sibeck-----Sacramento Office
 R. L. Sinkey-----Woodland

W. J. HARP-----Arcata
 E. R. Caldwell-----Eureka
 Scott Feland-----Fortuna
 Ed Johnson-----Garberville
 W. F. Kaliher-----Fortuna
 T. F. Miller-----Klamath

S. R. GILLOON-----Mt. Shasta
 Brice Hammack-----Yreka
 A. A. Jordan-----Alturas
 Paul Kehrer-----Fall River Mills
 C. R. Love-----Redding
 Fred Starr-----Madoel

S. J. CARPENTER-----Maxwell
 Roy W. Anderson-----Red Bluff
 Lee Atkinson-----Williams
 L. W. Dinsdale-----Yuba City
 Taylor London-----Oroville
 E. O. Wraith-----Chico

J. D. DONDERO-----
 Ray Diamond-----Willits
 Ovid Holmes-----Fort Bragg
 Geo. N. Johnson-----Napa
 Earl Macklin-----Ukiah

L. A. Mitchell-----Point Arena
 K. J. Ransdell-----Lakeport
 HENRY LENCIONI-----Santa Rosa
 J. H. Groves-----Cloverdale
 V. E. Vox Arx-----Santa Rosa
 JOSEPH H. SANDERS-----Truckee
 C. O. Fisher-----Susanville
 L. E. Mercer-----Quincy

J. E. NEWSOME-----Newman
 H. E. Black-----Madera
 C. L. Brown-----Mariposa
 M. S. Clark-----Merced
 C. L. Gourley-----Los Banos
 L. W. Longeway-----Sonora
 Geo. W. Magladry-----Modesto

J. O'CONNELL-----Stockton
 Alvin Granstrom-----Lodi
 Wm. Hoppe-----Tracy
 Lee Straight-----Walnut Grove
 Vernon Sutton-----Angels Camp
 J. W. Thornburg-----Jackson

E. W. SMALLEY-----Hanford
 F. A. Bullard-----Reedley
 R. J. Little-----Gridley

O. P. BROWNLOW-----Visalia
 Lester Arnold-----Bakersfield
 Ray J. Bullard-----Porterville
 W. I. Long-----Woodlake
 Roswell C. Welch-----Kernville

LOS ANGELES OFFICE

A. R. Ainsworth-----Santa Maria
 R. E. Bedwell-----Ventura
 E. H. Glidden-----San Diego
 J. H. Gyger-----Perris
 J. W. Harbuck-----Brawley
 W. L. Hare-----Santa Ana
 F. W. Hecker-----San Luis Obispo
 H. C. Jackson-----Santa Barbara
 T. R. Jolley-----Idyllwild
 W. S. Talbott-----Mecca
 C. L. Towers-----Los Angeles
 Paul Turner-----Paso Robles

LARUE F. CHAPPELL-----Pasadena
 W. C. Malone-----San Bernardino
 C. L. Savage-----Ontario

E. H. OBER-----Bishop
 A. F. Crocker-----Bridgeport
 Eugene Walker-----Independence
 C. J. Walters-----Independence

COMMERCIAL FISHERIES PATROL

S. H. LYONS, Supervisor Fisheries Patrol-----Terminal Island
 C. H. GROAT, Captain-----Terminal Island
 R. F. CLASSIC, Captain-----Monterey
 COBURN F. MADDOX, Captain-----San Diego
 N. C. Kunkel-----Terminal Island
 T. W. Schilling-----Pismo Beach
 T. J. Smith-----Terminal Island

Launch Patrol

Walter Engelke-----Motor Vessel "Bluefin," Terminal Island
 L. J. Weseth-----Launch "Albacore," Monterey
 Erol Greenleaf-----Launch "Albacore," Monterey
 C. M. Bouton-----Launch "Quinnat," San Rafael
 W. J. Black-----Launch "Hunter," Vallejo
 Wm. Hoppe-----Launch "Rainbow," Walnut Grove
 Geo. Smalley-----Launch "Walter R. Welch," Pittsburg
 T. F. Miller-----Launch "Silverside," Klamath

Captains indicated in capitals.

